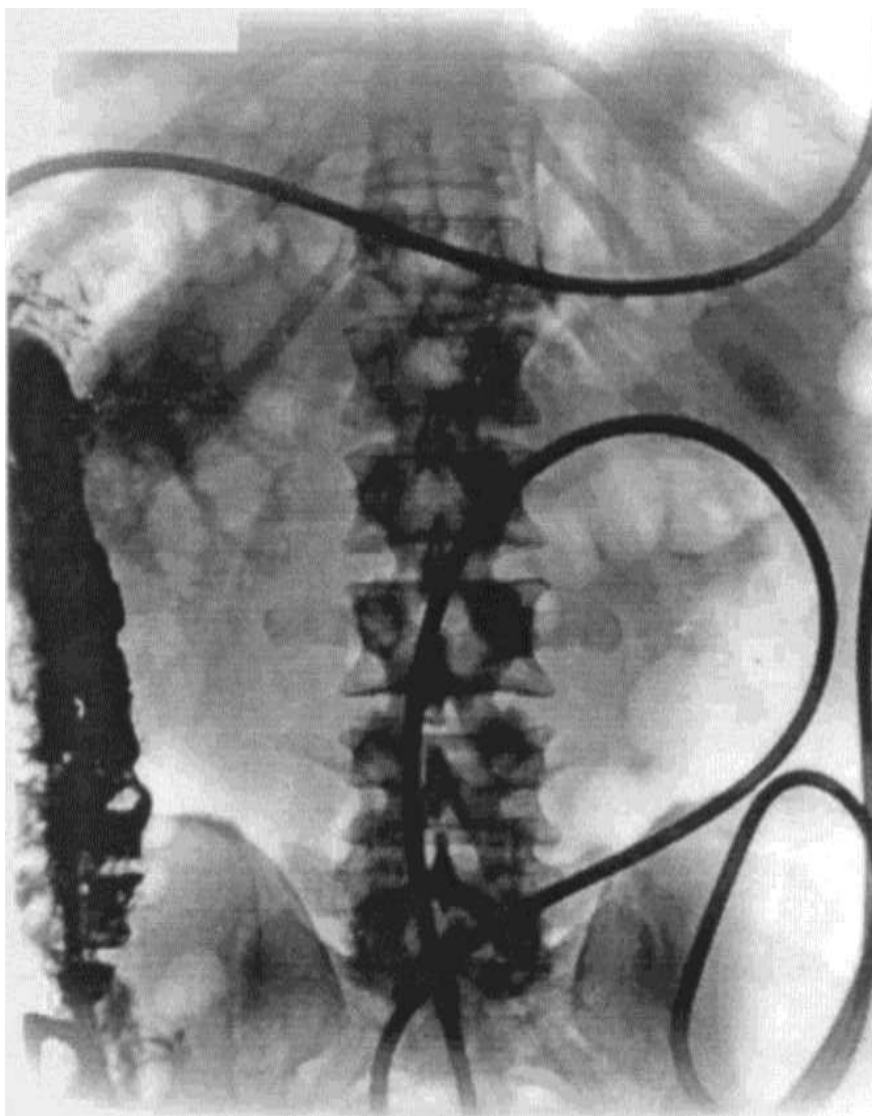


Sergey Matasov

Problems and Prospects of Intestinal Intubation



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**Problems and Prospects
of Intestinal Intubation**

Matasov S.A. Problems and prospects of intestinal intubation.
—152 p., 66 fig.

Monograph is written in 1992. However, due to financial reasons it was not published yet.

The monograph expounds the expediency, own theory and experience of creation of the “Colonoscope for family doctors”, assigned for early colon cancer diagnostics, and of the “Intestinal Intubator with drainage” suggested for the prophylaxis of relaparatomies, treatment of peritonitis and ileus. The edition is intended for students, surgeons, endoscopists, other doctors as well as health organizers, researchers and experts in medical equipment.

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These are the first copies of compact discs and therefore can contain mistakes. The author bring his apologies and will be grateful for Your information about them.

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«Neither do men light a candle
and put it under a bushel, but on
a candlestick; and it given light
unto all that are in the house.»
(St. Matthew, 5, 15).

INTRODUCTION TO «PROBLEMS AND PROSPECTS»

Problems associated with the introduction to the intestine of flexible tube appliances - drainage tubes, endoscopes and probes - might be of interest to students, surgeons, endoscopists, other medical specialists as well as health organizers, researchers and experts in medical equipment. It seems that I have found roots of some general and special problems. Thus, the first classification of methods of intestinal intubation resulted from identifying intubation forces; the localization of intubation forces on a tube led to the description of mechanisms of methods and formulation of theses of the study on intestinal intubation including the concept of the prospect; criteria of safety and effectiveness of intestinal drainage were worked out due to investigation of the existing drainage tubes for the colon.

140,000 new cases of cancer of the colon are registered only in the USA every year. 60,000 patients die from it annually. The basic problem consists in early detection of the disease (G. I. Vorobjov, 1989. In France colorectal cancer is the leading disease 25,000 cases a year), mortality rate amounts to 15,000 cases a year (C. Bories, 1988). Limited application of manual colonoscopy in this context is illustrated by A. I. Neugut and K. A. Forde (1988) in the article «Screening colonoscopy: Has the time come?». The summary points out that though colonoscopy is an expensive method of investigation means should be allotted to it. If colonoscopy reduces mortality by half it will amount to 15 saved lives per 1,000 adult population; economy on treatment and hospital maintenance

equals to 25,000 dollars per patient. The information should not be regarded as a direction to a physician to institute common colonoscopy for cancer screening of the colon but is aimed to stimulate its application for asymptomatic patients every 5-10 years.

There is nothing to object against this position, but, taking into account high cost and inconvenience of conventional colonoscopy, it is possible to realize this suggestion only by principally new colonoscope, which is meant primarily for family doctors.

Prolonged stagnation in abdominal surgery is evident: «The frequency of repeated surgical interventions in case of early intraabdominal complications has no tendency to decrease and equals from 0.29 to 5.1 %. Fatality after repeated operations remains high and varies from 21.4 to 55.8 %, peritonitis and ileus as complications give 70-90 %» (N.M.Zjubricky, 1989). Relaparotomy in 70 % of cases (Z. Golba, S. Kutypa, J. Misterka, 1980) is caused by these complication.

The frequency of relaparatomies can be reduced only by *a new method of prevention of peritonitis and ileus* which ensures: atraumatic, available to any surgeon transanal intubation of the intestine during 3 - 5 minutes; safe atraumatic lavage of the intestinal cavity.

All method of intestinal intubation were subjected to a concept analysis but the method of pneumatic intubation proved to be the most productive for the screening of people over 50 years old and prevention of relaparatomies. These targets can be realized with Colonoscope for Family Doctors and Intestinal Intubator with Drain.

THE BASIC PROBLEM OR YOU CANNOT CHOP WOOD WITH A PENKNIFE

In developed countries medicine is organized by their free citizens - in my country it is in the hands of people who combine academic, ministerial posts in the past were Party officials as well. The last place of our medicine is the direct result of their productivity. Efforts to get control over the intestinal endoscope of a new generation and intubator with the drain were made both in Moscow and in Riga. My incompatibility with the Latvian medical nomenclature headed by the Minister V.V. Kanep and his deputy for scientific work A. F. Blyuger manifested itself already in 1975 (V. M. Latyshev, 1982); their criticism was followed by an open rejection - threats, derangement of my thesis defense, attempts to take away the devices and hand them over to Moscow and ultimately - my dismissal from the Institute.* We had conflicts on other topics as well (U. Meistere, 1988).

The long «selection» time of the intubator and the new colonoscope is explained by their financing, too: means allotted to the theme during 12 years of my work at the Institute total less than 80,000 rubles. But for reproducing an obsolete model of a foreign manual colonoscope the research institute of proctology of the Health Ministry of Russia and its sponsor the Ministry of Defense of the USSR spent some million roubles. In 1984 having realized my unwillingness to work for a «Moscow uncle the «leading strategist» of home colonoscopy told me: «We shall be able to make your endoscope without you». The potential of our leading specialists appears to be so low that despite sufficient grants, close links with the military industrial complex and the government they are able neither to reproduce foreign devices nor to put into effect their own ideas.

** The scientific department of the Riga medical Institute cancelled my work practically annually from the moment it had been approved in 1978 contrary to A.F. Blyuger's wish; finally, they succeed in 1990.*

Having declared the plans to rebuild a prison for a domicile they dismantled bars and watch towers but left the same superiors. For example, in 1985 the future of talks with «MACRON» (Britain) on cooperation in producing my colonoscope was depended on the approval by clerks of five Moscow establishments. Invention of the Intestinal Colonoscope and its know-how was evaluated by the All-Union foreign trade Co. «Vneshtekhnica» at 5 mln USD, but as I was not plastic enough in the hands of the officials the promising talks were broken off. The task to discredit the work and the author was entrusted with the newspaper «Soviet Latvia» (O.Myhalevich, 1986, 1987), in Moscow with the «Medical newspaper» (B.Korchagyna, B.Lyholytov, 1987, 1988).

All experiments, described in the book, were carried out in the laboratory of the Military Hospital No 289. Officers of medical service V.S.Chystihin, V.S.Palagin, K.P.Zenkov contrary to authorities of the Health Ministry of LSSR organized its free of charge realization, but V.L.Sysojev and A.A.Motasov - people far from medical profession played the part of assistants.

The epigraph to my work should not be regarded as a reproof to anybody but it reveals my optimism. For today's results I want to thank both the opponents and followers of this work; each of these sides in its own manner deprive me of the moral right to have the negative result. Among the people, without disinterested assistance of whom the work would not have seen light, is my family, my friends, people I know well and not well, among whom I remember: J. Augskalns, J. Apsit, E.A. Babajan, M.P. Bezhinov, A. Builis, V. Vishkevich, A.A. Grinberg, J. Gulbis, J.M. Dederer, K.P. Zenkov, V.I. Ivanov, V. Ivankov, I. Ilynsky, D. Kremer, E. Linars, A.A. Motasov, G. Orlean, L.V. Orlova, E. Palivoda, V.S.Palagin, B.K. Pugo, D. Prieditis, V. Purmalis, V.P. Samosadkin, L. Sauleskalns, J. Semenov, P.P. Sergeyev, V. Sysojev, V.F. Tolpezhnikov, L.A. Tutans, V.S. Chistihin, V. Shahaev, M. Schinkis, O.P. Schepin. At the end of this, certainly not complete list I must mention the operators of computer page-proof A.R. Dashkevich, V.A. Janchin who took part in the creation of this book. The book is dedicated to my grandfather Sarkys Abramyan from Van, my father Alexander Matasov, and my friend Victor Latyshev, to all whom medicine failed to help.

Riga. July 1992

Part One

PROBLEMS

Chapter 1

**PROBLEMS OF EXSTRASURGICAL PROCEDURES
OF INTESTINAL EVACUATION AND INTUBATION**

The first attempts of intubation of the gastrointestinal tract were preceded by conventional techniques of its evacuation. An enema used for injecting liquid into the colon was known to ancient Egyptians. A purgative enema acting on receptors of the ampoule of the rectum stimulates intestinal peristalsis and thus ensures emptying of the intestine. A siphon enema does not only activate intestinal peristalsis - under the force of gravity the introduced liquid moves in the colon like a piston carrying along its content.

Laxatives have been also known since ancient times. Modern medications for activating contractile activity of the intestinal wall include anticholines-terasive agents, ganglioblocators, sympatolitics as well as a hypertonic solution of natrium chloride, pituitrin.

Novocaine was widely used for the treatment of intestinal pareses. In various concentrations, amounts and combinations with other agents it has been recommended for administration parentally, intravenously, intraarterially, intraabdominally, to the mesentery root of the small intestine.

Hypertonic natrium chloride is as widely used as novocaine. A. Korkelija and A. Betanely (1973), who investigated the laxative effect of some preparations using the method of phonography of the abdominal cavity, noted that following intravenous administration of a 10% solution of natrium chloride (at a rate of 1.0 ml per 1.0 kg patient's weight) tones increase in 4 - 18 min and last 10 - 70 min. The action of prozerine (1.0

ml of a 0,05 % solution intramuscularly) according to the data provided by these authors occurs in 15 - 35 min following the injection and lasts 15-105 min. The authors point out that its efficiency depends on severity of intestinal paresis: " Fast and potent effect of prozerine is a favourable sign of a slight degree of postoperative intestinal paresis. Delayed and short-term action of prozerine points on a severe degree of postoperative intestinal paresis". E.O. Nepokoichicky and A. V. Belenkov (1978) also stressed the diagnostic value of drug stimulation of the intestinal motor activity. They considered lack of response to administration of sormantol should be an indication to a surgeon to perform an operative intervention.

Long peridural anaesthesia (LPA) is one of the types of drug action on the motor activity of the gastrointestinal tract. D. I. Darensky and G.D.Kalzanov (1979) stressing certain clinical efficiency of LPA, pointed out its disadvantages and complications such as complexity of the peridural space catheterization, decrease of the arterial pressure, periduritis, meningoence-phalitis. K. L. Dreijer et al (1982) related efficacy and safety of LPA to the right position of a catheter in the peridural space, O. S. Schanin (1982) - to its accurate performance. V. D. Seidov and A. A. Geibullaev (1988) suggest to improve treatment of dynamic ileus by combining LPA with hyperbaric oxygenation and administration of heparin.

V. A. Stupin, A. V. Fjodorov, A. P. Simonenkov (1989) supplemented the list of medications: they used one of serotonin salts for treatment of postoperative paresis.

The variety agents, sometimes having antagonistic mechanism of action, reflects both a complexity of the syndrome pathogenesis and lack of appropriate pharmacological solution of the problem.

First attempt to use electricity for stimulating peristalsis of the gastrointestinal tract were made in the XIX century. Amplitude, frequency, form, phase, other characteristics of impulses applied to electrodes were specified simultaneously with the development of theory and practice of electrical engineering. At present several techniques of applying electrodes are known. When using a monopolar technique an indifferent (+) electrode is placed on the skin and an active (-) one within the organ (the stomach, the duodenum, the rectum or a fistula). A bipolar technique of electrostimulation consists of putting positive and negative electrodes within the organ. A combined technique requires positioning of an indifferent electrode on the skin and two active ones within the organ. A technique when both electrodes are in contact only with the skin is also described. (A. A. Vishnevsky, A. V. Zivshie, M. P. Viljansky, 1978).

The approach to intestinal electrostimulation is not similar. For example, some investigators note that application of this procedure during the first 24 h following the operation is ineffective. A. A. Reut, S. N. Shugaev (1979) gave reasons for delayed application of electrostimulation : "It was found that if electrostimulation is performed during the first three days and initiated within 24 h after the operation then, following the local stimulating action of the electric current, the basic effect results in depression of the motor function of the intestine after discontinuing irritation. Therefore, it is not advisable to apply electrostimulation earlier than on the 3-rd - 4-th day after the operation".

It is unlikely that, if absorption capacity of the intestine is affected, electrostimulation could ensure evacuation of its content accumulated over a period of 3 - 4 days.

G.L.Aleksandrovich, N.I.Bojarincev (1979) also pointed out that non-intubational methods for combating functional ileus are not efficient enough: "It has been

proved by a long-term experience that application of medication and other means for intestinal paresis treatment is frequently ineffective".

The so-called gastric tubation has been known since the end of the eighteenth century. During the first three-quarters of the nineteenth century a gradual shift from hard gastric tubes to soft rubber ones took place, mandrins were rejected. A.Hammerchlag (1907) stated that gastric lavage in conditions described as its acute distention was first applied by Kussmaul.

A A. Beljaev (1962) wrote that in Russia a problem of transnasal gastric intubation in case of peritonitis was posed by N. I. Napalkov in 1927, the first publication on clinical application of systematic suction of the gastric content in the postoperative period was made by A. P. Nadein in 1937.

Despite the definite value of the chosen direction, gastric intubation could not radically change the patient's condition in case of peritonitis or ileus: it is known that during operations for these diseases the air and fluid content in the small bowel, found even when the stomach is empty, can amount to some litres. A. G. Kononov, M. A. Abdulajev (1987), in their article "Is nasogastric drainage effective for paresis following operations on the colon and the rectum?" reported negative results of a long-term gastric intubation without serious consideration for it.

At the end of the XIX - beginning of the XX centuries *manual intubation** of gastrointestinal tract was undertaken in retrograde direction, too. A.Shule (1909) extraoperative intubation of the colon with a probe resembling a pliable tube tightly put on a spiral spring and a ball-like end: "In some cases the instrument can reach the S-like curvature. But numerous experiments proved that it is practically impossible to advance

* The method is defined considering the source of intubation force

further a probe either coils in ampoule recti or bulges the S-like curvature to the left below the ribs. In such cases patients often complain of a severe pain".

Flexible endoscopes that permitted to adapt a distal end of tube to the axis of the intestinal canal have not fully solved the problem of manual intubation of the colon. The basic problems of colonoscopy procedure are associated with the necessity of straightening and pleating mobile parts of the colon on a colonoscope by its reciprocating, translational-rotary, reciprocating-rotary motions (Fig. 1).

According to the summary data by V. S. Saveljev, V. M. Bujanov, A. S. Balalykin (1977) the possibility of successful, so-called total colonoscopies varies from 49 to 95 %, according to S. A. Julykov et al. (1987) it amounts to 73.6 % (it was effective in 1127 cases out of 1532).

O. I. Zinovjev (1974) considered the cause of incomplete colonoscopy in 71.5 % of cases to be due to loops of mobile parts of the colon, V. A. Romanov, V. A. Shalimov (1976) regarded the basic obstacle for introducing a colonoscope to be a combined effect of loops of the sigmoid and transverse colons, occasionally the sharp angle of the splenic curvature: traverse of these parts was accompanied in a patient by painful sensations.

According to V. P. Strekalovsky (1983) a number of complications following 18,000 diagnostic colonoscopies that required operative intervention amounts to 0.02 % - 3 perforations and 1 bleeding (bleeding in two patients was stopped by a conservative treatment). Foreign authors (citation by S. J. Dolecky et al., (1984) consider the incidence complications to be higher: I. F. Panis (1976) - 102 perforations per 44,680 colonoscopies (0.2 %), in 15 cases a patient died (0.03 %); P.

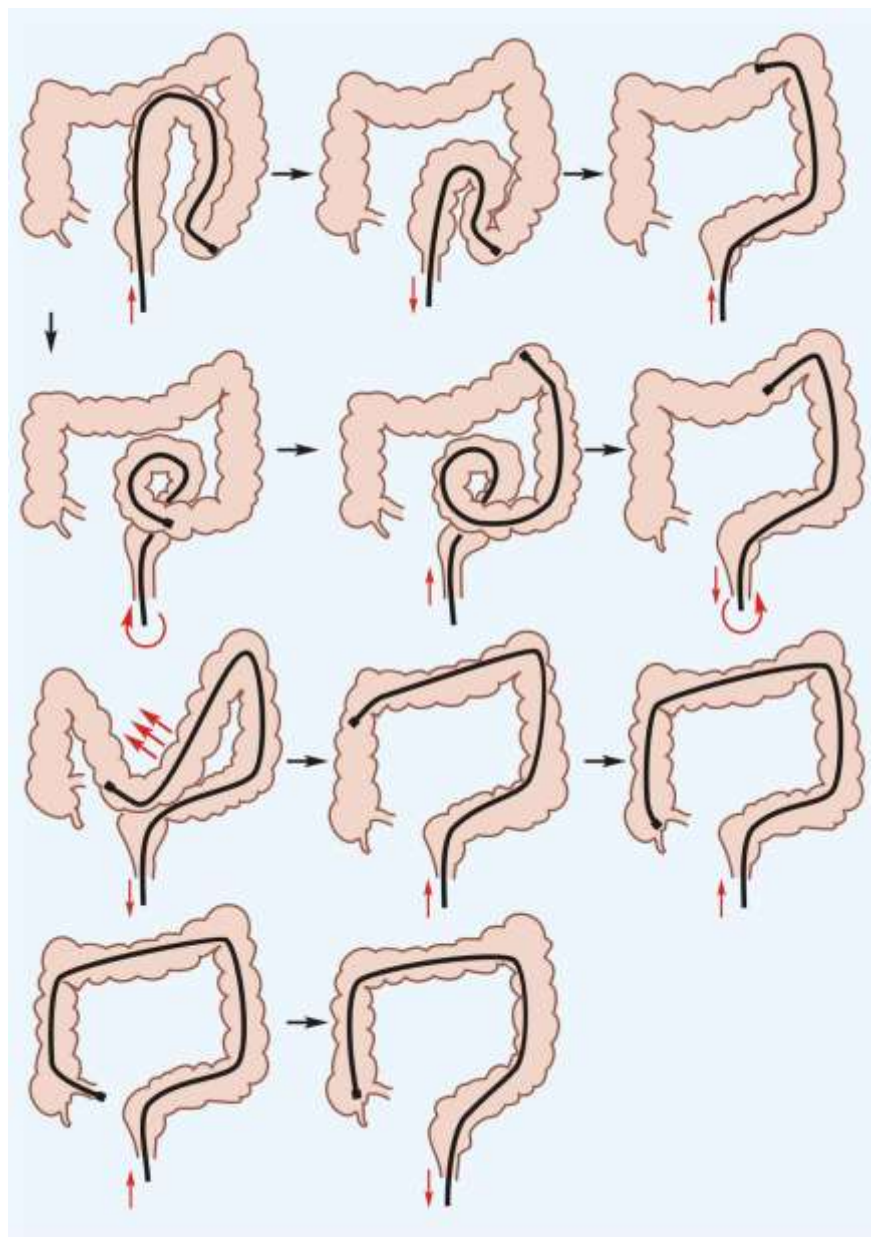


Fig.1. Manual Intubation. The bowel straightening technique at colonoscopy (rendered illustration from the book "Endoscopy of organs of abdominal cavity", V.S. Saveljev et al., 1977)

Fruhmoergen, L, Demling (1979) - 57 perforations per 35,890 colonoscopies (0.14 %) with 7 fatal cases (0.02 %). According to the latter investigators a number of perforations and bleeding at colonoscopy accompanied by polypectomy varies from 0.14 to 2.24 %, i. e. 1 complication per 200 - 500 colonoscopies.

Lately, cancer of the colon has advanced to one of the leading diseases in economically developed countries. In the ex-Soviet Union colonoscopy in combination with other methods of examination secured early diagnosis of cancer of the colon only in 20 % of patients (V.I.Uljanov.A.S. Varjuhin, 1983). "Practically each fourth patient with the primary diagnosis of cancer of the colon belongs to the fourth clinical group, in some regions the number reaches 50 %". Data provided by the 4-th Chief department of the Russian Ministry of Health reflects the potential of colonoscopy in the general dispensary system (G. A. Rybinsky et al., 1986): among 1062 examined patients aged from 16 to 86 years, polyps were revealed in 363, cancer in 19 patients.

Difficulties in insertion of colonoscope and their deficiency resulted in introduction of sigmoidoscopes but their application is risky: I. A. Erohin, B. N. Silina, S. L. Akinchev (1981) provided data that a tumour in the left part of the colon was detected in 92, in the right part - in 73, in the transverse colon - in 16 patients.

A. S. Balalykin, A. A. Raszhivin (1989) showed the importance of colonoscopy in emergency surgery: "Data obtained by emergent colonoscopy supplement a patient's clinical picture and ensure selection of the most appropriate method of treatment, the optimum time for surgical interventions".

Endoscopy of the mobile part of the small intestine is rare. In 1978 V. P. Strekalovsky, S. L. Hankin reported about transanal examination of 0.1 to

1m of the ileum. Later V. P. Strekalovsky (1982) and Japanese researchers K. Kawai, M. Tada et al. (1982) performed transoral manual endoscopy of 1 m of the small intestine (Fig. 2.).

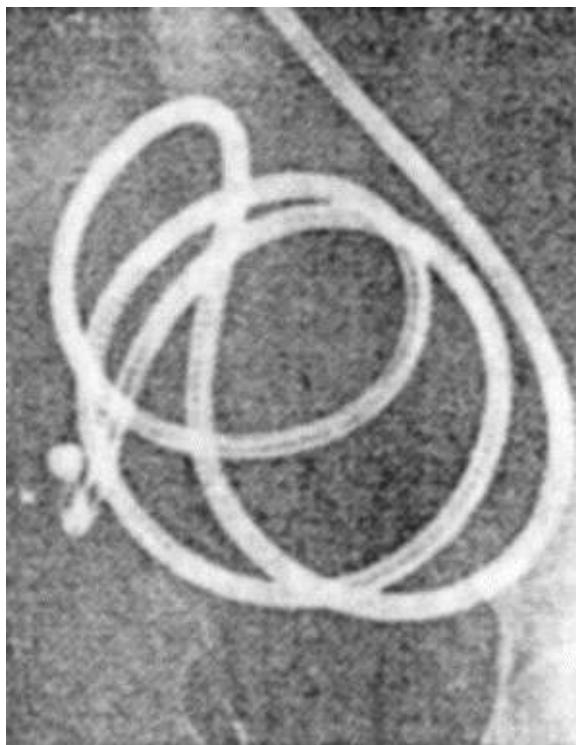


Fig. 2. Transoral intestinoscopy using the method of manual intubation
(a roentgenogram from the article by K. Kawai and M.Tada, 1982.)

Four years later V. P. Strekalovsky et al. (1986) informed that without an operation but under general anaesthesia and X-ray control the small intestine till "the terminal part of the ileum" was examined in 2 patients per os. Researchers used a 1.7 m long colonoscope made by "Asahi Pentax" Co., Japan.

*The method of functional intestinal intubation** has been also elaborated at the beginning of our century. The stages of its development have been taken by me from A. J. Gubergic and J. V. Linevsky (1975). In 1908 Sheltema succeeded in advancing a rubber tube down the whole child's gastrointestinal tract. In 1931 Jones, forspeeding-up functional intestinal, attached a thin-walled balloon to the inner end of a tube. Miller-Abbott tube made by "Rusch" Co. resembles a two-channel tube, a smaller channel is connected to an air balloon and a bigger one has a number of holes for suction of the intestinal content. The holes, as it is seen in Fig. 3, are positioned near the balloon. A Miller-Abbott probe's tube is made of roentgen-contrast rubber and has marks indicating the depth of insertion. It is 3.1 m long for adults and 2.3 m for children.



Fig. 3. Miller-Abbott probe (from the catalogue of "Rusch" Co., 1986)

A new approach to functional intubation was made by Harris who in 1944 recommended to fill a latex balloon not with air but with 4-8 ml of mercury. A one-channel probe with a mercury filled balloon is presented in the catalogue of "Rusch" Co. under the name of Cantor. It is 3.1 m long (Fig. 4).

The passage of a Cantor probe down the duodenum is negotiated considering its anatomy - by placing a patient into a position which allows to use traction of mercury mass; A. A. Beljaev (1956) spend on duodenal intubation from 4.5 to 6 hours. Long-term and ineffectual blind intubation of the pylori and duodenum led to the application of endoscopes for this purpose (K.Meissner, 1978; J. V. Sinev, A. V. Kovanev, A. V. Sokolinsky, 1988).

* *Intubation by intestinal muscles, which depends on the condition of the motor-evacuatory function of the intestine, I defined as functional.*

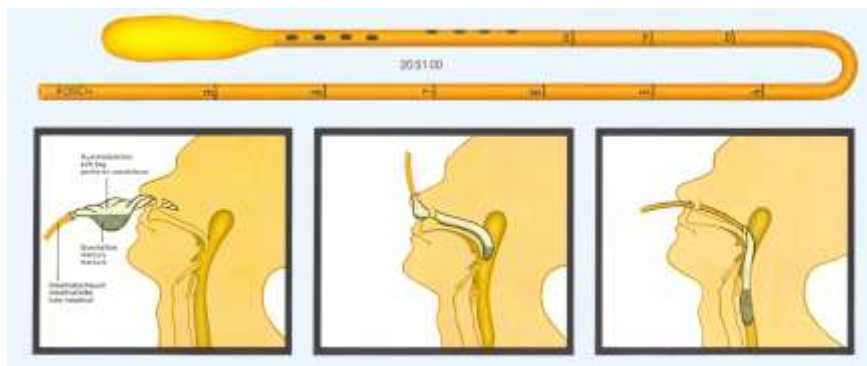


Fig. 4. Cantor probe and a starting moment of its insertion (from the catalogue of "Rusch" Co., 1986)

In general, functional intestinal intubation is propelled due to stimulation of intestinal peristalsis with mercury mass or a large volume of an air filled balloon. All authors without exception define balloons of Cantor, Miller-Abbott probes as leading and point out that they are a force point of intestinal muscular efforts: "Peristaltic waves, by pushing a distended cuff in the aboral direction ensure probe's progress to the desired level" (J. M. Dederer, 1971).

Data provided by J. M. Dederer and A. V. Kuinovsky (1977) show shortcomings of functional intestinal intubation for the treatment of ileus: a pronounced vomiting reflex did not allow to insert probe and leave it in the stomach in 18 patients, to the attempts to pass a probe from the stomach to the duodenum were ineffective in 54 cases, in 72 patients intubation of the small intestine was accomplished successfully. Thus, the author concludes that functional intestinal intubation is a success in 50 % of cases.

To illustrate drawbacks of a long-term application of Miller-Abbott and Cantor probes J.M. Dederer (1971) referred to foreign author's

experience: Farris, Smith (1956) reported 238 cases of the larynx stricture (79 of which required tracheotomy) and 22 cases of the esophagus stricture; Gerber, Rogers, Smith (1956) revealed a high risk of pneumonia among intubated patients - in nonintubated patients the incidence of pneumonia is 4.5 times less.

J. M. Dederer (1971) also enumerates other complications induced by the method of functional intestinal intubation: "rupture of varicose veins of the esophagus, perforation of the stomach and intestine when applying probes with mercury filled bags, secondary ileus due to knotting of a probe, leakage of mercury from a probe, etc". Considering possibilities of complications both on intubation and extubation A.A. Beljaev (1956) emphasized the necessity to follow extubation speed at 60-70 cm/h.

Possibility of applying functional intubation for examination of the small intestine (Fig. 5) was discussed at the Japanese-Soviet symposium "Endoscope-82" (November 24 - 25, 1982, Moscow Research Institute of Proctology of the Russian Ministry of Health). V. P. Sokolovsky, G. D. Kolesnikova, V. M. Arabolinsky delivered results of 12 clinical trials of a probe's type uncontrollable intestinoscope produced by "OLYMPUS" Co. and being 2850 mm long with a diameter of 5 mm. Researchers provided data that the average intubation time amounts to 4 hours, 300 cm of the small intestine were examined in 9 patients, the whole small intestine - in 2 patients, in 1 patient an attempt to traverse a device through the pylorus was a failure.

M. Tada et al. (1982), Japanese participants of the symposium, informed about tests on 8 patients of an intestinoscope made by "OLYMPUS" Co. with the length of 2730 mm and 8 mm in diameter with four-direction

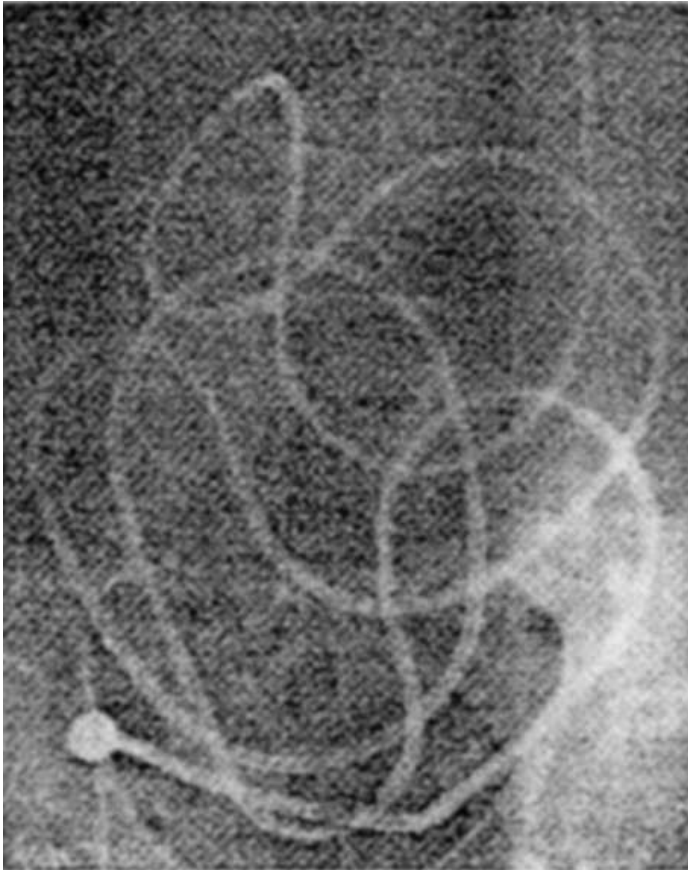


Fig. 5. Endoscopy of the small bowel using the method of functional intubation. (A roentgenogram from the article by K. Kawai, M. Tada, 1982)

flexible distal end fitted with an inflated balloon. The probe was inserted by manual pushing in 2 patients: 10 cm of the jejunum were covered in 20 min, 80 cm in 40 min. In 6 cases "the device was inserted in a natural way without exerting control over the flexible distal end and as a result in 20-150 min it was other advanced at 120-160 cm down the duodenojejunal curvature to the inferior part of the jejunum or the ileum. Expecting further passage of the probe to the terminal part of the small intestine researchers has been observing its movement for 30-100 min but it did not advance".

21 PROBLEMS. *Intestinoscopy by the method of manual intestinal extubation, by the "monorail" and "rope-way" methods*

The authors also point out that "having inserted the device about 1 m down the duodenojejunal curvature and formation of 3 - 4 coils a control over the distal end of the endoscope was blocked though biopsy forceps had been".

Besides intestinoscopy by manual and functional methods, Japanese investigators reported about a "rope-way" method which comprises 2 stages of intestinal intubation. The stage of functional intubation is accomplished with a guide (thin tube or thread) coming out of the anus, then one of its ends is attached to the inner end of endoscope. The second stage of intubation consists of drawing out guide from one natural orifice of the tract and consequently pulling endoscope, which follows a guide into the opposite orifice (Fig. 6). Thus the second stage of intubation by a "rope-way" method is accomplished by *the method of manual intestinal extubation*.*

An intestinoscopy by "monorail" as well as by a "rope-way" begins with a complete (or total) functional intubation of the intestine and is completed with the help of hands. The technique was not even mentioned in the papers of the symposium "Endoscope-82". R. K. Rahmanov (1988), in his reviewing article "Endoscopy of the small intestine" on insertion of an endoscope using a "monorail" method, discusses the problem very sparingly. He writes that "it (an endoscope) can move along a catheter towards the intestinal tract as by rail".

It follows from the literature that the "rope-way" and "monorail" methods do not exclude full intestinal intubation but have a high degree of risk. Among reasons for their limited practical application I would like also to mention their extremely long duration and insufficient informativeness.

* *The method is defined by me considering its implementing force and its direction*

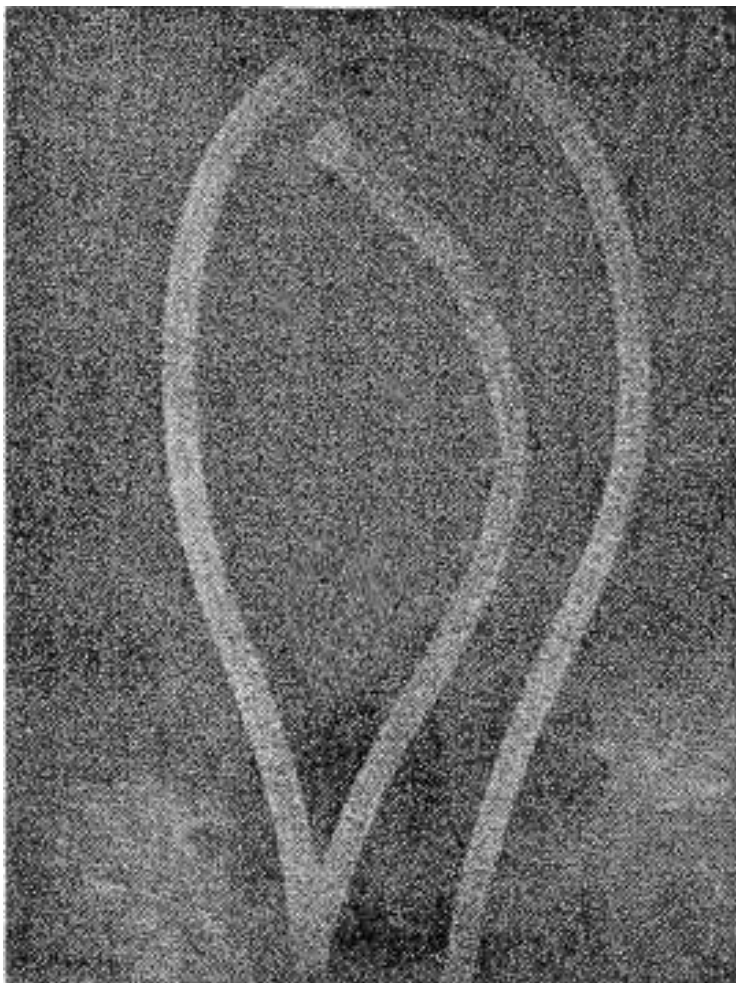


Fig. 6. Transanal variant of the method of intestinoscopy by a "rope-way"
(a roentgenogram from the article by K. Kawai and M.Tada, 1982)

V. P. Strekalovsky gave the final assessment of possibilities of the small intestinal intubation: "All techniques of endoscopic examination of the small intestine have not yet found a wide clinical application because new devices as well as novel techniques of their insertion into the small intestine are required".

A completely new approach is represented by the method of *pneumatic intubation of the intestine*.* The everting thin-walled tube into the intestine by means of the air are described by many inventors (A. A. Zjabbarov, "A device for contrast roentgenologic investigation of hollow organs", 1969; D. Silverman, "A medical instrument for everything a thin-walled flexible tube", 1970; K.J. Bocharov, "A device for administration of remedies", 1978, etc.).

One device should be singled out and it is the apparatus made by A. A. Zjabbarov which has been already tested on humans (Fig. 7). It consists of a thin-walled latex tube 1, a transparent chamber 3 to which a source of air pressure 4, a manometer 5, branch pipes 9,2 are connected. In the process of setting the device to work the thin-walled tube 1 is placed

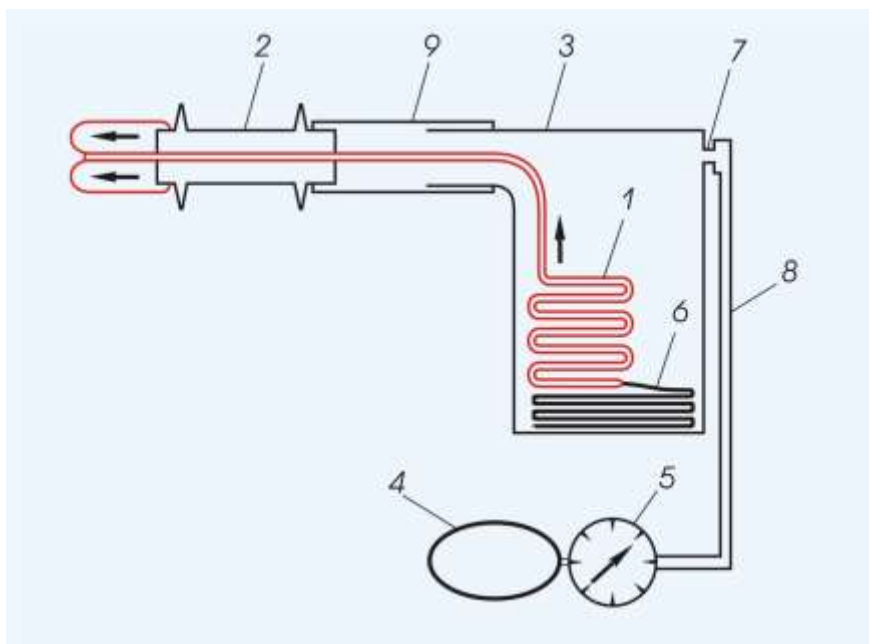


Fig. 7. Rendered illustration of USSR invention No. 240915 by A. A. Zjabbarov (1969)

* I defined the method considering its implementation by the force of pressed air.

within the chamber 3 and its open end is passed out, then turned inside out and hermetically sealed on the branch pipe 2. Having inserted the branch pipe 2 into the anus, the inner (non-everted) part of the tube 1 begins to evert under the action of redundant air pressure, advances from the chamber 3, branch pipes 9,2 and, as A. A. Zjabbarov (1972) puts it, rolls on the mucosa of the intestine. A string 6 attached to the tail – the closed inner end of the tube 1, the inventor supposed to use for measuring the depth of intubation and withdrawal of the tube.

In the article "Self-directing telescopic probe for intestinal investigation" A. A. Zjabbarov (1972) describes application of his device for tumour diagnosis of the colon by its negative contrasting and the technique of getting images of the intestinal mucosa. By negative contrasting the author implies roentgenoscopy of the intestine against the air filled thin-walled tube 1. A. A. Zjabbarov got images of the mucous membrane by means of a photosensitive layer or a layer of rapid polymerizing plastic applied on the inner surface of the tube 1.

Manufacturing of the thin-walled tube 1 of vegetable latex with a considerable stretching ability ensures a strong contact between its working layer and the mucosa of the colon. The level of air pressure within the thin-walled tube 1 is not given in the article A. A. Zjabbarov illustrated the efficacy of his device with a roentgenogram as it cannot be reproduced because of a bad quality of the picture. I will describe it: cylinder-like body with a smooth wall is within the rectum, sigmoid and descending colons of the man. The roentgenogram proves that A. A. Zjabbarov is a pioneer of pneumatic intubation.

Chapter 2.

PROBLEMS OF PALPATORY INTUBATION AND OTHER SURGICAL PROCEDURES OF INTESTINAL EVACUATION

Before *the method of palpatory* intestinal intubation* has been elaborated the surgical procedure for the treatment of functional ileus consisted of forming a stoma, milking of the intestine, puncture of the bowel.

Having analyzed result of 385 enterostomies undertaken at the Institute named after Sklifosovsky from 1947 to 1957, A. A. Beljaev, N. V. Bistrov (1958) pouted out that complications occurred in each third patient, including: retraction of an enterostoma from the anterior abdominal wall in 4.43 % of cases, a phlegmon and an abscess round a stoma amount to 3.65 %, not closing of a fistula for more than 20 days about 14 %, etc. The authors consider that surgeon's skeptical attitude to the treatment of functional ileus by a stoma is also due to a failure of an enterostoma to function properly during the first days in one-third of all patients, it did not secure emptying of the upper portions of the tract. But on the other hand they noted that it is sometimes a decisive factor in saving the patient's life.

Limited possibilities of an enterostoma were pointed out by other surgeons as well. For example, V. S. Deshkevich (1965) marked that even multiple stomata were useless in cases when paralysis of the gastrointestinal tract had developed. Nevertheless, he did not see a perspective of treating functional ileus without enterostomy either and stressed the importance of an early stoma formation giving preference to a lip-form fistula.

Attempts to rehabilitate an enterostoma for the treatment of functional ileus are made at present as well (M. A. Topchibashev, T. A. Burtikova, 1977, etc.).

* *The method implemented by the force of surgeon's fingers in contact with a tube, unlike the manual method accomplished, through the intestinal wall, is defined by me as palpatory.*

The main contradiction, passed without notice by investigators who by broadening or limiting indications for enterostomy and changing its technique tried to use a stoma for the treatment of functional ileus, is manifested by V. I. Struchkov (1956): «If peristalsis is present - ileostomy is useless, if not - ileostomy cannot ensure evacuation of the intestinal content».

Milking is one of the surgical techniques for emptying the small intestine. According to this technique, air and fluid are stripped into the large bowel or towards the place of opening of the small intestine by surgeon's fingers gliding along the small intestine pressed between them. A.P.Oleksa (1957) characterized this manipulation as dangerous: «It can cause more damage to the affected intestinal walls, development of subserous hemorrhages, rupture of the serosa or the intestinal wall». J. M. Dederer (1971) criticized intestinal milking from a different angle: «Milking having been performed, we repeatedly noticed a stable decrease of the arterial pressure and pulse acceleration. A postoperative period in patients after milking is more complicated than in cases of evacuation of the intestinal content by a less traumatic technique».

I found an attempt to justify this manipulation in the report by Hollender et al. (1974). They undertook milking, referred to as cautious, of the intestinal content in 93 patients with mechanical ileus. Complications occurred in 3 cases and all of them - a fistula, an abscess, adhesion - were localized at the place of the incision of the bowel. B. F. Brodsky, I. J. Zaharchik (1982, 1983) also reported that they successfully used milking of the small and in children.

The resolution on acute ileus adopted by as far back as the 26 All-Union Congress of Surgeons (1956) reads: «A compulsory condition for restoring intestinal tube passability consists of emptying the stomach and the intestine from the air and fluid content. Milking being a crude

technique should be replaced by evacuation through a puncture. A method of constant suction of the gastrointestinal content through the upper portions of the gastrointestinal tract deserves attention (a thin probe). Ileostomy as an additional technique for these purposes should have strictly limited indications».

Special instruments have been designed for emptying through a puncture: a pliable tip incorporated with a suction pump (A. P. Oleksa, 1957), an irrigoaspirator (J. T. Komarovskiy, L. N. Forisjuk, 1969), etc. The basic elements of the instruments are two concentrically combined tubes one of which is meant for suction of the intestinal content, the second one - for introducing air or fluid into the bowel. The presence of two channels considerably simplifies evacuation, excludes clogging of instrument's holes with the mucosa. The instruments are not long as in the process of evacuation the small intestine is placed on them.

The first demerit of intraoperative intestinal evacuation techniques is the hazard of infecting the abdominal cavity due to the necessity of opening the bowel. The second drawback is that one-time evacuation of the intestinal content does not prevent the intestine from being full again. J. M. Dederer (1971) wrote; «It was constantly observed that in 2 - 3 days after the operation these patients developed marked abdominal distention even following a thorough intestinal evacuation, enlarged non-peristaltic intestinal loops are outlined through the extended abdominal wall».

The method of palpatory intubation is applied at an operation for tubation of the intestine; in a postoperative period a perforated tube of different size serves as an intestinal drain. A number of reports at the 4-th Russian Congress of Surgeons in Perm in 1973 dealt with the method. Some years later the editorial board of the journal «Surgery» warned surgeons of too simplified approach to a new technique. In a commentary to the article by I. N. Grygovich, A. B. Valdeman, V. N. Shujgin (1979) it is said;

«Intestinal intubation especially in children is a traumatic manipulation attended by severe complications and should be performed only in severe cases when the traditional methods of prevention and treatment of paresis ... appear to be ineffective».

I have detailed and systematized literature on the method of palpatory intestinal intubation. The following five problems of the method have been outlined:

- selection of a variant of intestinal intubation;
- intestinal injury induced by intubation;
- efficacy of tubular drains;
- physical interaction of a tube and the intestine;
- extubation of the intestine.

1.2.1. VARIANTS OF PALPATORY METHOD

There are five basic variants of the method of palpatory intubation of the small intestine at present - two antegrade and three retrograde: transnasal or transoral, via a gastro-, ileo-, cecostoma and transanal.

Painful sensations in the nasopharynx that force patients to remove a drain, pneumonia, otolaryngologic and other complications reported on describing the method of functional intestinal intubation compel surgeons to cut the time of keeping a transnasal drain in the gastro-intestinal tract. According to the majority of authors the average time of leaving a transnasal drain in the intestine does not exceed 4 - 5 days.

It should be noted that surgeons are likely to give preference to the transnasal variant of palpatory intubation of the small intestine. For example, B. I. Miroshnikov, B. E. Tibilov (1985) intubated 25 patients transnasally, 11 via an ileostoma, 10 through a cecostoma, 4 through a gastrostoma. A. A. Shtrapov, N. V. Ruljada (1986) intubated transnasally

12 patients out of 25, 9 via an ileostoma, 3 transgastrically, and 1 patient through a cecostoma. A. J. Gauens, A. M. Engelis, M. M. Veveris (1986), V. G. Dorofeev et al. (1987) wrote only about the transoral variant of the method.

Intestinal intubation through a gastrostoma saves a patient the trouble of tolerating a foreign body in the nasopharynx, prevents development of pneumonia, allows longer and thus fuller restoration of absorption and motor-evacuatory functions of the gastro-intestinal tract (J. M. Dederer, 1962, 1965; E A. Krasovska, V. T. Ashurbekov, 1974), ensures possibility of splinting the small intestine for the purpose of preventing commisures, for example, during 14 days (B P. Volkov, A. J. Moiseev, T. P. Prohorova, 1986). Polish surgeons C. Gagata et al. (1988) performed 62 out of 81 intubations through the gastric wall; a probe was kept in the intestine from 17 to 30 days.

The well-known disadvantages of both antegrade variants of the method are difficulties in negotiating advancement of a drain down the fixed duodenum.

A variant of intubation of the small intestine via an ileostoma (I. D. Zhytnjuk, 1965; M. J. Cheidze, 1970), which together with a transgastral variant has paved us the way for all others types, eliminates the necessity to pass a drain through the fixed portions of the tract restricting the jejunum and the ileum from both sides.

In 70-th a transcecal introduction of a drain challenged the variant of intubation of the small intestine via an ileostoma. The hazard of bending and stenosis of the terminal segment of the ileum as a result of stoma formation on the one hand and a large calibre of the cecum on the other have made transcecal intubation of the small intestine especially popular among pediatric surgeons. Nevertheless, due to the fact that the cecum

is often involved into an inflammatory process and introduction of the drain's tip through the ileocecal anastomosis presents difficulties, intubation of the small intestine via an ileostoma has not lost its importance.

J. M. Dederer, A. V. Kunovsky (1977) observed failure of a gastrostoma in 5 out of 92 patients intubated using their variant, all 5 patients having been operated for peritonitis. Rather discouraging results of transgastric intubation in 7 cases are provided by J. L. Shalkov, P. E. Nechitajlo, T. A. Gryshina (1977): 5 patients died, at the autopsy in 4 patients operated for peritonitis retraction of a stoma from the abdominal wall was revealed.

By comparing the rejected enterostomic (non-intubational) method of emptying the intestine with transstomatic variants of the palpatory method, common complications and ways of their prevention have been found. For example, V. S. Deshkevich (1965) and A. I. Guzeev (1973) unlike their predecessors of the method advocate formation of a lip-form fistula for prevention of ileostoma inefficacy. But it implies a compulsory repeated operation for fistula closure.

Complications characteristic of the transcecal variant of palpatory intubation of the small intestine are associated with infection of the anterior abdominal wall in the circumference of a stoma. According to J. M. Dederer, A. V. Kunovsky (1977) such complications were observed in 9 out of 22 cases intubated through a cecostoma, 1 patient has, as the authors write, a severe intraabdominal complications. To prevent inefficacy of a cecostoma and ensure its independent closure I. N. Grygovich, A. B. Valdeman, V. N. Shuigyn (1979) fixed the cecum not the skin but 1.5 cm deeper than the derma-abdominal suture. The authors observed oozing of cecum content into the abdominal cavity in 1 out of 31 patients intubated through a cecostoma, in 9 patients it was closed by an operative procedure.

Complications following transstomatic variants of the palpatory method arise not only because of the inflammation in the abdominal cavity but of the fistula content as well, for example, aggressive at transgastric intubation and considerably infected at transcecal.

Life-threatening complications on the part of organs and tissues surrounding the insertion place of a drain into the intestine exclude the transanal variant of intestinal intubation, besides, it is the only one which implies combined discharge of the colon, the ileum and the jejunum. S. J. Dolecky et al. (1973) applied this variant in the complex of curative measures for peritonitis and acute ileus in 28 pediatric cases. When faced with difficulties of navigating a drain through the colon, V. E. Schitinin, A. V. Arapova (1978), followers of S. J. Dolecky recommended to intubate it through a ceco- or ileostoma. According to their data 55 children, ranged in age from 3 month to 14 years, were intubated: 27 patients transnasally, 18 through an enterostoma, 7 transnasally, 3 via a cecostoma. The authors emphasized that drain insertion through a cecostoma considerably simplifies the procedure, diminishes intestinal injury. The authors consider the splenic angle and ileocecal valve to be the most difficult places to traverse.

I.N. Grygovich, A. B. Valdeman, V. N. Shuigyn (1979) regarded the hepatic flexure and the retrosigmoidal segment of the colon to be places which also interfere insertion. These pediatric surgeons gave preference to transcecal intubation of the small intestine: 31 intubations were performed through a cecostoma, 9 via the anus, 3 via an ileostoma, 2 by mouth. Patients intubated through the anus were mainly new-borns.

O. S. Mysharev, L. E. Kotovych (1977) also advocated the transcecal variant of pediatric intubation I have not found information in the current literature on transanal palpatory intubation of the ileum and the jejunum in

patients adults. Attempts to undertake the total intubation of the gastrointestinal tract led to its so-called triple drainage (P. N. Napalkov, B. I. Miroshnikov, 1973; V. S. Kachrin, 1974): into the stomach, the duodenum and the jejunum a drain was introduced transnasally or through a gastrostoma; into the ileum - through a cecostoma; a third tube was inserted transanally up to the splenic angle. J. L. Shalkov, P. E. Nechitajlo, T. A. Gryshina (1977) intubated 18 patients with transoral and transanal drains: a transanal tube was usually introduced up to the splenic or hepatic angle of the colon, in 4 patients it was advanced even to the distal portion of the ileum.

There are other unconventional variants of the palpatory method. For example, A. N. Berkutov (1974) who was also trying to perform a complete intestinal intubation used a cecostoma for retrograde intubation of the small intestine and antegrade of the colon. K. Meissner (1976) proposed an atypical variant of the small intestinal intubation that can be defined as a through ceco-gastric variant and allows to use both ends of a tube. B. I. Polyglotov (1988), who advocates not only the idea of decompression and drainage of the larger portion of the intestine but the so-called controlled intestinal dialysis as well, suggests to accomplish it through an enterostoma formed «at any segment of the small intestine at surgeon's discretion»: one of two tubes is introduced in the retrograde direction up to the ligament of Treitz, a second one - in the antegrade direction if necessary up to the right side of the colon.

A clear exception from a tendency to complete intubation of the gastrointestinal tract is data provided by V. G. Muha (1987) who suggested to perform retrograde intubation of the jejunum through a jejunostoma at the depth of 15 - 20 cm.

Views differ an application of variants of the palpatory method. I want to mention two extreme ones. The position of pluralists was formulated by J. L. Shalkov, P. E. Nechitajlo, T. A. Gryshina (1977): «A probe can be introduced by nose, through a gastro- or ileostoma, by rectum or cecum. We do not consider that strict rules should be followed as each of the aforementioned ways has positive and negative aspect». A surgical society of Moscow and its area is a stronghold of supporters of the transnasal variant of the palpatory method; proves, for example, in favour of small intestinal intubation through an ileostoma have been disregarded by the society (Z. A. Ender, 1988).

1.2.2. ABOUT INTUBATIONAL INJURY

Intestinal injury induced by intubation depends on intubational technique, surgeon's experience, a variant of the method, design of a drain.

Due to a number of reasons, the pioneers of the method of palpatory intestinal intubation make their drains in the majority of cases independently. One of tube opening which seems appropriate to a surgeon is usually closed with an olive or with any other tip and side holes are made in the tube part meant for introduction into the stomach and the intestine.

Palpatory introduction of a drain through fixed portions of the gastro-intestinal tract depends on tube pliability. To facilitate manipulations through the intestinal wall some inventors reduced flexibility of a drain end by putting on it some rings made from a tube serving as a base for a drain. For temporary increase of drain flexibility. N. S. Androsov (1971) applied a mandrin made of non-corrosive wire, N. N. Kanshin (1980) - a device resembling biopsy forceps of a flexible endoscope, but some inventors even frizzed a drain which contained water.

In the majority of cases, palpatory intestinal intubation is accomplished by palpation of a drain through the intestinal wall. I. N. Grygorovich, A. B. Valdman, V. N. Shuigyn (1979) describe intubation of the mobile portion of the small intestine: «Pleating of the gut on a probe is performed by an assistant who goffers the intestine on a probe (15 - 20 cm in one go) ..., then he pulls a probe by an olive at a corresponding distance».

The minimum time of palpatory intestinal intubation is in case of drain introduction through an ileostoma - from 10 to 15 min (J. A. Gegechkory, R. S. Popovjanc, 1977) and the time is twice as long when a drain is inserted through a natural orifice (G. Kormann, Ch. Wuttke, 1983).

I did not find information on the study of intestinal injury induced by intubation: trauma induced by the palpatory method can be evaluated only from accidental remarks. For example, A. L. Prusova and N. S. Popandopolo (1983) write about the intubation technique: «A probe should be advanced by careful pleating of the bowels on it with the following goffering and then pushing of the probe through the pleated portion A probe must not be pulled by an olive as this manipulation can cause rupture of the mucosa».

I.D. Zhytnjuk (1956) gives a pathological description of the intubated bowel: «Collapse of the small intestine, its walls and the mesentery are edematous, vessels are dilated. The mucosa is thin, folds are smoothed out, and it is covered with spot hemorrhages along its entire length. Histological examination revealed thrombosis of some intestinal vessels, oedema of the submucous layer. The muscular coat is oedematous, at some parts fibrilated, ruptures of some fibers and their necrosis are observed». I D. Zhytnjuk considered the cause of the aforementioned morphological changes of the small intestine to be peritonitis and functional ileus, but he disregarded palpatory action of a surgeon on its

tissues during intubation. An indirect prove of trauma associated with palpatory intubation of the small intestine through an ileostoma can be found in the same article that describes a case history of a patient who died from ulcerated enteritis on the 23-rd day after removal of a drain. V. S. Saveljev, V. M. Bujanov, A. S. Balalykin (1977) describing intraoperational gastroduodenoscopy pointed out that surgical manipulations with the stomach and duodenum may be accompanied by trauma of the mucosa, result in intramucous hemorrhages and even bleeding. A. A. Sherbakov (1974), G. L. Aleksandrovich, F. N. Panasjan, N. I. Bojarincev (1979) described cases of intestinal bleeding following palpatory intubation.

P. E. Nechitajlo (1978) evaluated intestinal function following palpatory intubation by means of electroenterography. During the first hours after the operation the author noted deeper suppression of motor activity of the intestine in the group of intubated patients as compared with the operated patients without intubation.

A clear example of trauma induced by palpatory intestinal intubation is given by D. G. Veller, P. E. Nechitajlo (1981) who described a fatal case from peritonitis as a result of unnoticed perforation of the cecum during traverse of a drain through the ileocecal anastomosis.

A new and probably less traumatic technique of the small bowel intubation than a conventional procedure was suggested by B. A. Kostovsky (1976): introduction of a drain through a cecostoma into the jejunum-ileum should be proceeded by its pleating on a 23 cm long hard tube-guide; following introduction of a drain through a hard tube and pulling by a drain olive, the bowel will slide down the guide but the drain lie on the intestinal mucosa. This technique can also be utilized for intubation of the mobile portion of the small intestine through an ileostoma (L. F. Vinnik, R. I. Zhytnjuk, 1978) as well as via an

enterostoma (V. I. Polyglotov, 1988); its application for intubation via other stomata or natural apertures is impermissible.

1.2.3. ON VARIANTS AND EFFICACY OF INTESTINAL DRAINS

Efficacy of emptying the gastrointestinal tract depends primarily on the length of the inserted tube. It seems that the limit to palpatory intubation of the tract on using two antegrade variants of the method is set by the ascending colon, when using three retrograde variants the proximal segment of the jejunum. Data provided by P. Symich (1979) concerning the length of the jejunum and the ileum (3.75 m), the colon (1.2 m) permit to find out the average length of the gastrointestinal segment in contact with a tube when applying this or that variant of the small intestinal intubation. The average length must amount: on intubation by nose or mouth to 4.8 m, through a gastrostoma - 4.3 m, through an ileo- or cecostoma - 3.75 m, through the anus - 5 m.

To study the length and other characteristics of employed intestinal drains a table 1 has been made where the most distinctive features of the material aspect of the palpatory method are presented in chronological order. Question marks in the table reflect absence of the corresponding data in the reviewed works and insufficient attention of authors to the subject of my study in general.

Analysis of vertical columns 2 and 3 reveals a clear tendency to increase the length of the drain intrainstestinal part for all the variants of the method though it does not exceed 3 m. Disproportion between the length of the drain intrainstestinal part and the length of the aforementioned intubated portions of the tract is explained by so-called straightening-shortening (goffering) of the mobile portions of the intestine on a tube.

Review of Literature on Intestinal Drains

Table 1

Authors, the year of publication	Variant of intestinal intubation	Length of a drain, m	Drain's basic element	Drain's calibres, mm	Size of side holes, mm	Number of side holes of drain
1	2	3	4	5	6	7
J.M. Dederer, 1962	via a gastrostoma	1 - 1.5	rubber tube	ext.* 7 - 8	5 x 8	13
I.D. Zhytnjuk, 1965	via an ileostoma	1.2- 1.5	rubber tube	ext. 7 - 8	?	6 - 8
M.J. Cheidze, 1970	via an ileostoma	1.5 - 2	rubber tube	ext. 7 - 8	?	15 -20
N.S.Androsof, 1971	by mouth	1.5	rubber tube	ext. 7	?	16 -17
J.M. Dederer et al., 1971	via a gastrostoma	1	a new gastric probe	ext.10-12 int.* 5-6	5 x 8	4 - 5
S.J. Dolecky et al., 1973	by anus	1 - 1.5	p/e* tube	ext. 7-8	5 x 6	13 - 15
A.I. Guzeev, 1973	via an ileostoma	1.5- 2.5	rubber tube	ext. 10 int. 5	?	?
E.A. Stepanov et al., 1974	via a gastrostoma	1.5 - 2	tube of ?	?	?	more than 150
A.A.Sherbakov, 1974; V.B.Aleksandrov et al., 1974	by nose	3	two-,triple-channel rubber tube	?	?	27
V.A.Kostovsky 1976,	via a cecostoma	2.5 - 3	rubber tube	?	?	15
O.B.Porembsky R.I.Zhytnjuk, 1976	via an ileostoma	?	rubber tube	ext. 7 - 8	15 x 6	?
J.L.Shalkov et al., 1977	by nose	2.5 - 3	tube of p v.chl.*	ext. 6 - 8 int. 4 - 5	2	50 - 70

Table 1

1	2	3	4	5	6	7
J.A.Gegechkory, R.S.Popovjanc, 1977	via an ileostoma	2.8- 3	rubber tube	ext. 8-10 int. ?	?	14
J.M.Dederer, A.V.Kunovsky 1977	via a gastrostoma	0.8	gastric probe	ext.10-12 int. 5 - 6	«Not very large»	8 - 10
O.S.Mysharev L.E.Kotovitch, 1977	via a cecostoma	0.6	silicon tube	?	?	some
V.E.Shchytinin, A.V.Arapova 1978	via anus, a cecostoma	1.5- 2	silicon tube	ext. 10 int. 6	2.5	50
I.N.Grigovich et al., 1979	via a cecostoma	3	one or two combined p. v. chl. tubes	ext. ? int. 6 – 7 ext. 3 int. ?	2	?
N.N.Kanshin 1980	by nose	?	silicon tube with a channel within a wall	ext. 11 int. ?	?	?
A.L.Prusov, N.S.Popandopolo, 1983	by nose	1.5- 3	two combined tubes ext. of p/e int. of fl/pl*	ext. ? int. 8 ext. 2.5 int. ?	?	150
G.Kormann, Ch.Wuttke, 1983	by nose	3	tube of p. v. chl.	ext. 7 int. 5	2	26
V.G.Dorofeev, et al.,1987	by nose	1.5- 1.7	tube of p/e	ext. 3 - 5 int. ?	1.5 - 2	15-17
V.I.Polyglotov, 1988	via an enterostoma	1.2- 2	tube of p. v. cl.	ext. ? int.from 4-5 to 2.8	1.8 - 2	up to 8

* Abbreviations: p/e - polyethylene; p. v. cl. - polyvinylchloride; fl/pl - fluoraplast;
ext. - external; int. – internal.

I.N. Grygovich, A. B. Valdman, V. N. Shuigyn (1979) warned of negative consequences of straightening the jejunum and the ileum on a drain for their evacuation: «It should be stressed that after a probe has been inserted, the bowel on it must not be goffered as in some hours following the operation a goffered portion of the intestine «slips» and thus considerably lesser portion of it remains intubated.». «Slipping» can be prevented by using a drain, which resembles the Miller-Abbot probe. Cl. Galibert (1979) suggested it for the transgastral variant of intubation: having reached the ascending colon, a balloon was filled with fluid and thus fixed the reached level of the small intestinal intubation.

For a theoretical analysis of emptying the intestine O. S. Mysharev, V. V. Trojan (1982) used a modified formula by Poiseuill:

$$Q = \frac{\pi \Delta P \mathfrak{R}^4}{8 l \mu}$$

where:

- Q - stands for velocity of fluid down a tube,
- ΔP - difference of pressures within a cavity and a tube,
- l - the length of a tube,
- \mathfrak{R} - its radius,
- μ - a viscosity index of fluid.

Guided by inverse dependence between l and Q but, probably, not knowing about slipping of the placated bowel from a drain, the authors shortened its length up to 20 - 25 cm for new-borns and to 60 - 70 cm for children, ages 14 - 15.

Proportional dependence between ΔP and Q is illustrated by unforced emptying of the extended small intestine during intubation. To increase the difference of pressures within the intestine and a drain in the postoperative period, the external end of the latter is attached to the

source of negative pressure. For evacuation of the small intestinal content I. N. Grygovich, A. B. Valdman, V. N. Shuigyn (1979) used the minimum vacuum - not more than 10 mm of w. c. (about 0.001 kgf/cm^2 *). G. Kormann, Ch. Wuttke (1983) ten times higher pressure - up to 50 cm of w.c. (about 0.05 kgf/cm^2). A new procedure for active drainage of different cavities was suggested by V. G. Hymichev, P. M. Shorlujan, Sh. A. Tenchurin (1983): negative pressure within a tube was made during 1-2min with the interval of 3-5min, within the limits of 40-70 mm of w. c. (about $0.004 - 0.007 \text{ kgf/cm}^2$). For wound drainage J. N. Jusupov, M. V. Epyfanov (1987) experimentally proved much higher pressure - 80 mm of Hg (a bit higher than 0.1 kgf/cm^2). In suppurative surgery J. A. Davydov (1988) applied pressure of 76-114 mm of Hg.

V. I. Polyglotov (1988) emptied the intestine by short-term vacuum within the limits of $0.2 - 0.8 \text{ kgf/cm}^2$. It seems that the author did not study the consequences of such vacuum action on the intestinal mucosa.

According to data provided by F. N. Panasjan (1974) the amount of fluid content of the ileum and the jejunum evacuated through a drain introduced via an ileostoma equals: on the 1st and 5th postoperative days - 0.5 l; on the 2nd, 3rd and 4th days - about 0.7 - 0.8 l; on the 6th and 8th days - about 0.08 and 0.05 l correspondingly. A sharp decrease of fluid discharged through a drain during the last days. I think, is explained by obturation of a drain due to the increase of viscosity of the small intestinal content.

Inverse dependence between μ and Q sooner and more dangerously is revealed when using the transanal variant of the small intestinal intubation. Possible clogging of a transanal drain led to the fact that this variant of the method was rejected by the majority of pediatric surgeons

* The ratio between pressure units: 1 mm of w.c.=9.80665 Pa; 1 mm of Hg = 133,332 Pa; $1 \text{ kgf/cm}^2 = 98066.5 \text{ Pa}$

O. S. Mysharev, L. E. Kotovych (1977) pointed out in this respect that a drain maintained patency only for 2 - 3 days, then it was obstructed with the intestinal content. I. N. Grygovich, A. B. Valdman, V. N. Shuigyn (1979) supporting the transcecal variant of the small intestinal intubation referred to 2 patients in whom obturation of a drain was revealed at the level of the descending segment of the colon.

Efficacy of fluid injections into a drain for its recanalization mainly depends on a number and size of its side holes. However, data in the columns 6 and 7 of the table 1 show that a tendency to diminish the size of drain: side holes was accompanied by a considerable increase of their number. The following drains are an exception from the last tendency: a drain y G. Kormann, Ch. Wuttke (1983) - 26 holes with the diameter of 2 mm, a drain y V. G. Dorofeev et al. (1987) – 15-17 holes with the diameter of 1.5 - 2 mm and a drain by V. I. Polyglotov (1988) - less than 8 holes with the diameter of 1.8 - 2 mm.

One-channel drains are often ineffective not only because of high viscosity of the intestinal content: bending of a tube due to the influence of the intestinal axis, pressure of other organs in the abdominal cavity can practically completely obstruct its lumen. Two-channel drains are less affected by obturation with the intestinal content. Nevertheless, I think that their wide application is hindered due to large resilience.

1.2.4. ON PHYSICAL INTERACTION OF A TUBE AND THE INTESTINE

Intubated portions of the jejunum and ileum look unnatural as if put on a frame, mainly in the form of semi-circles passing one into another. Already in the 1960s this forced alteration of the position of the intestine, defined as its shunting, led some investigators to the idea of preventing relapses of commisure ileus (M. Reifferscheidt, R. Philips, 1965;

O. Meffert, H. Bure, 1974; W. Kapral, 1977; . P. Volkov, A. J. Moiseev, T. P. Prohorova, 1986).

Trying not only increase safety of shunting and intestinal emptying but to facilitate a preceding palpatory intubation of the intestine as well, surgeons consistently followed the road of increasing resilience of intestinal drains. At first, as it is shown in columns 4 and 5 of the table 1, J. M. Dederer, A.V. Ovchinnikov, B. E. Sudorogin (1971), A. I. Guzeev (1973), J. A. Gegechkory, R. S. Popovjanc (1977 for manufacturing intestinal drains made use not of rubber tubes with little resilience and 7 - 8 mm in an external diameter but more thick-walled ones with a diameter of 10 - 11 mm. Increase of thickness of an intestinal drain wall was followed by their qualitative substitution. In our country S. J. Dolecky et al. (1973) first described application of an intestinal drain made of a plastic tube. At the end of 1970-s, rubber intestinal drain were virtually everywhere replaced by polyvynylchloride ones, which are «resilient and elastic,...have less friction» (J. L. Shalkov, P. E. Nechitajlo, T. A. Gryshina, 1977), and silicon tubes.

Resiliency of drains depends not only on the material of a tube and thickness of its walls but the size of its side holes as well. As it is shown in columns 4 and 6 of the table 1 transition to plastic intestinal drains was accompanied by considerable diminishing of the side hole calibre.

In the way of increasing drain resilience more farther have gone K. F. Lebzark (1978), A. L. Prusov, N. S. Popandopolo (1983): their drains resemble two concentrically combined plastic tubes; polyethylene tubes must be rather resilient, too.

As experience of intestinal intubation was being accumulated, information appeared in literature about cases of physical action of drains on the gastrointestinal tract. Thus, J. M. Dederer, A. V. Ovchinnikov, V. E.

Sudorogin (1971) noted 2 cases of duodenum perforation, besides, perforation of the mobile portion of the small intestine - at autopsy it was revealed that the end of an intestinal probe, considered to be the basic element of the intestinal drain, was located in the free abdominal cavity. A. A. Sherbakov (1974) provided information about stomach decubitus found at section, triple-channel rubber probe having been kept in the intestine for less than 5 days. Due to the menace of necrosis H. Stutter (1976) considered shunting of the intestine to be impermissible if its wall is in a poor condition.

Intestinal decubiti and perforations are described when applying plastic intestinal drains, too. V. E. Schetynin, A. V. Arapova (1978) observed this complication of the method in 2, but O. S. Mysharev, V. V. Trojan (1982) in 4 children. D. G. Veller, P. E. Nechitajlo (1981) found decubiti at the place of crossing of the intubated bowel with a «glove-like tubular» drain of the abdominal cavity; one patient developed decubitus due to pressure of the drain end on the bowel.

As far as I know, nobody studied physico-mechanical properties of drains in general and physical force exerted on the intestinal wall of various intubated intestinal portions in particular. In the context of physical interaction of a drain and the intestine it is interesting to view the data provided by S. J. Dolecky et al. (1984): the amount of the rectosigmoid curvature up to the age of 10 may vary from 20 to 67 degree, the angle of passage of the sigmoid colon into the descending colon - from 28 to 80 degree, the splenic angle in the frontal projection from 20 to 40 degree, in lateral - from 12 to 27 degree, the hepatic angle from 58 to 95 degree.

1.2.5. ON INTESTINAL EXTUBATION

J. M. Dederer (1971) suggests to remove an intestinal drain with the speed of 10 - 15 cm per hour, V. A. Kostovsky (1978) advocated to

perform it three - four times faster - within the limits of 30 - 40 cm per hour. J. B. Martov, V. V. Anychkov (1977) - the authors who described invagination of the small intestine on extubation through a cecostoma, made the following conclusion: «Occurrence of the complication we associate with application for intestinal intubation of a rubber tube at withdrawal of which a strong friction is produced and this leads to invagination. We consider it is expedient to administer vaseline oil into the lumen of the intestine 1 - 1.5 hours before extubation».

Without casting doubts on certain merits of these recommendations I am determined to state that the speed of intestinal extubation and a friction index are important but they are secondary constituents of the process. The chief factor of its safety - a definite amount of extubating force. A safe procedure of removing long (about 1m and more tubes from the intestine can be worked out by investigating an extubation mechanism and systematic approach to intestinal in general.

Part Two**ROOTS OF PROBLEMS AND PROSPECTS.****Chapter 3****REVISION OF THE METHOD
OF PALPATORY INTUBATION OF THE INTESTINE**

For the last 30 years the method has been elaborated empirically mainly without its trials by authorities that give permission to apply new remedies on patients. Notwithstanding the existence of five variants of intestinal drain introduction and some suggestions to improve intubation technique, I have not come across any works dealing with the study of intestinal trauma induced by intubation. Despite a great number of publications on clinical application of new drain models, their safety and efficacy criteria have not yet been worked out. The present information on drains (material, tube's calibre, its length, size and setting of side holes that is aimed at their amateur manufacturing excludes an objective assessment of tube action on the intestine in the postoperative period.

Problems by solving of which I tried to get rid of its subjective assessment, can be formulated as following:

- to find out the safe pressure level on the intestine, to assess surgeon's palpatory force;
- to determine indices of intestinal injury induced by intubation, to investigate them for the palpatory method;
- to detect resilience and flexibility indices for intestinal tubes, to determine them for the most wide-spread intestinal drains;
- to find out indices of drain recanalization and intestinal irrigation, to assess them.

2.3.1. ASSESSMENT OF SURGEON'S PALPATORY CAPACITY

Analysis of palpatory intestinal intubation technique has showed that holding of a tube and the intestine during the first stage - formation of a longitudinal wave, and during the second one - displacement of it down a drain, is accomplished by flexors of the fingers 1 and 2, 3; fingers 4 and 5 are playing an auxiliary role (Fig. 8).

Ten surgeons from the First Riga Hospital with some experience in transoral palpatory intestinal intubation took part in the experiment. On inquiry it was revealed that the surgeons did not know the force of their fingers and as a result could not assess the level of pressure on the intestine during drain introduction. As the majority of surgeons expressed a view that the manipulation could not be accomplished by delicate efforts, I decided to study the potential of palpatory force.

Taking into account the characteristic movements during palpatory intestinal intubation a flexor dynamometer of fingers 1-3 has been worked out (Fig.9). Surgeons recorded their force three times alternating the right with the left hand. Measurement results are presented in table 2.

Proceeding from the obtained results the force of the fingers 1-3 varied from 7 to 12 kgf. Assuming that the working contact area of the three fingers with the bowel amounts to 4 cm^2 , then the potential of pressure exerted on the bowel at palpatory intubation equals about 2.4 kgf/cm^2 .

Assessment of the obtained results is only possible by comparing them with a criterion of safe manipulation with the intestine. There are no works aimed at its finding. Proceeding from the conventional conception of interconditionality of organ's anatomy and its function, «atraumatic

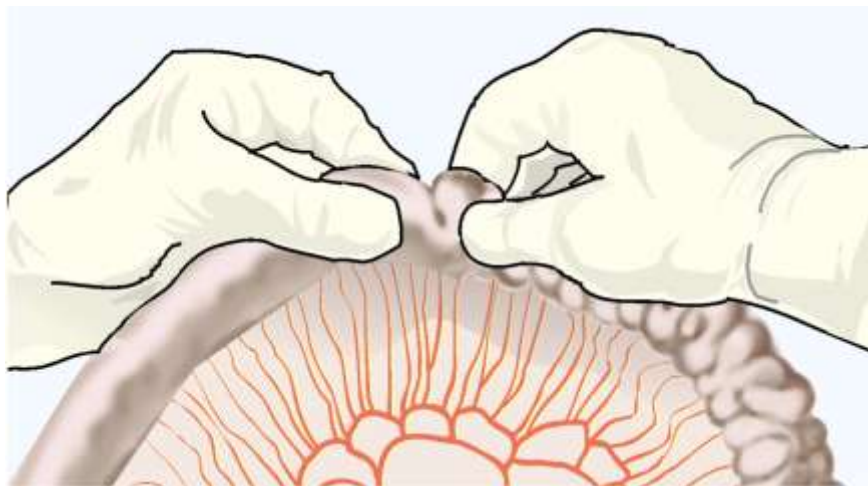


Fig. 8. Illustration to palpatory intubation technique

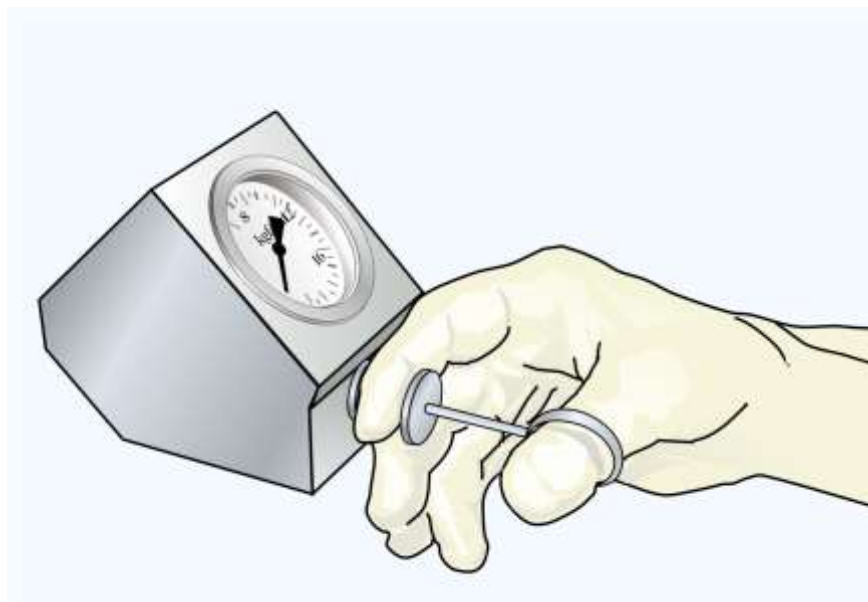


Fig.9. A syringe attached to a manometer – the basic elements of a flexor dynamometer of the fingers 1-3

**Force Measurement Results
of a Surgeon's 1-3 Fingers.**

Table 2.

No of Measu re-ments	Surgeon's initials	Right hand Force (kgf)	The average force of the right hand (kgf)	Left hand force (kgf)	The average force of the left hand (kgf)
1.	G. S. G.	10.0	9.17	12.0	11.67
2.		9.5		12.0	
3.		8.0		11.0	
4.	G. K. A.	9.25	9.75	11.0	11.0
5.		10.5		10.5	
6.		9.5		11.5	
7.	D. B. A.	11.0	11.17	9.7	9.65
8.		12.0		9.75	
9.		10.5		9.5	
10.	K. P. N.	10.5	9.5	9.5	8.92
11.		9.0		8.5	
12.		9.0		8.75	
13.	K. V. V.	10.0	9.08	9.0	9.67
14.		9.0		10.0	
15.		8.25		10.0	
16.	L. J. A.	11.0	9.5	10.5	10.17
17.		9.0		10.0	
18.		8.5		10.0	
19.	M. S. A.	12.0	12.0	10.5	10.75
20.		12.0		11.0	
21.		12.0		10.75	
22.	M. J. L.	9.5	9.0	8.25	8.17
23.		9.0		8.25	
24.		8.5		8.0	
25.	P. V. E.	7.75	7.67	8.0	7.5
26.		7.5		7.5	
27.		7.75		7.0	
28.	S. A. Z.	10.0	10.17	11.0	11.3
29.		10.0		12.0	
30.		10.5		11.0	
M±μ		9.7±1.14		9.88±1.3	

strength reserve» of intestinal tissues is determined by the maximum level of pressure produced by them. Thus, the *maximum physiological pressure produced by the bowel* I suggest to regard as the *pressure limit on it*. According to physiologists (E. B. Barbsky, A. M. Sorin, S. N. Davydov, 1975) the maximum pressure established in the small intestine does not exceed 120 cm of w. c. but in the colon less than 40 cm of w. c. Proceeding from these numbers let us consider that: 0.12 kgf/cm² - the pressure limit on the small intestine; 0.04 kgf/cm² - the pressure limit on the colon.

The number suggests that to ensure safe intubation of the small intestine the pressure exerted on it must be 20 times less than the potential of palpatory pressure (2.4 kgf/cm²: 0.12 kgf/cm²=20).*

Trying to make manipulations with the intestine harmless, we must keep in mind other factors causing its injury, for example, higher sensibility of intestinal tissues to physical force in case of peritonitis and ileus.

2.3.2. ASSESSMENT OF INTUBATIONAL INJURY

A drain used in experiments for studying intestinal injury induced by intubation was made on recommendations by J. L. Sharikov, P. E. Nechytajlo, T. A. Gryshina (1977), V. E. Schetynin, A. V. Arapova (1978). A polyvinylchloride tube (medical prescription P.M42) with an external diameter of 6 mm and internal of 4 mm was taken for its manufacturing. 7 rings made from the same tube were pressed 2 cm apart on the distal part of a drain with an olive at its tip. Side holes with 2 mm in diameter 40 mm apart were drilled at drain's part meant for introduction into the intestine. To facilitate intubation an anal funnel with an obturator was made (Fig. 10).

* *In this connection I think that a dynamometer will not solve the problem of atraumatic palpatory intubation but will be useful for unexperienced surgeons.*



Fig.10 Intestinal drain and anal funnel with an obturator

Experiments were conducted on healthy dogs. The small intestine of the living dog is from 2 to 6 m long, the length of the colon does not exceed 0.56 m (B. M. Hromov, 1972). The canine duodenum is much alike as the jejunum and the ileum, the large intestine by configuration and mobility resembles the human sigmoid colon. In general, transanal intubation of a dog can be equated with intubation through a cecostoma of the human ileum and the jejunum. Selection of healthy animals allowed to produce intubation-induced intestinal injury in a pure form.

Criteria of intubation injury are not found in literature. Due to multi-layer structure of the intestine I suggest to assess injury induced by this or that method according to *the layer-by-layer extent of intubation injury*, i. e. a distance from the place of tube insertion into the intestine up to the furthest from it damaged area of each layer.

Investigation was carried out on 10 breedless animals of both sexes. In the morning before the operation they were not fed. 30 min before the operation the dogs were administered natrii tiapental intravenously (5-10 mg/kg weight) and atropine intramuscularly (0.03 - 0.05 mg/kg weight). Having become drowsy and having lost ability to resist, the dogs were fixed to an operating table on the back with a specially made M-like support. Afterwards, anaesthesia was kept up by aether inhalation, in addition, natrii tiapental was administered.

Abdominal cavity was opened by a median incision, then the root of the intestinal mesentery was infiltrated with a 0,25% solution of novocaine and its length was measured. The length of the intestine was established by measuring a string passed along the center of the intestinal tube.

The distal part of the colon was intubated by combined efforts of a surgeon and his assistant who carried out an unsterile part of work. The assistant, having inserted an anal funnel, introduced the end of a vaseline oiled drain into the rectum: at the same time, the surgeon negotiated the olive advancement in the retrograde direction with fingers. Joint introduction of the drain at the depth of 20 cm enabled partly to eventrate the intubated portion of the colon and directly start palpatory intubation.

Palpatory intubation of the intestine was performed by repetition of the following two techniques on recommendations by I. N. Grygovich, A. B. Valdman, V. N. Shuigyn (1979). On making the first procedure the surgeon seized the drain at the distance of 10 - 15 cm from the olive with the right hand fingers but with the left hand pleated an additional portion of the bowel on it. The second technique fully reproduced milking of the intestine: holding the olive with the left hand the surgeon advanced a created longitudinal intestinal wave down the drain in the anal direction. For successful maneuver of the wave it was necessary that the left-hand fingers should catch and fix the drain at the immediate proximity from it.

At the end of this cycle, a portion of the drain was introduced into the rectum and the wave disappeared.

Navigation of the drain from the large into the small intestine required the knowledge of anatomy of the canine ileocecal angle and some experience.

The intrainestinal part of the drain becoming longer, it was more difficult to advance the intestinal wave down it. This was felt by fingers and revealed itself by gradual diminishing of the drain portion pulled into the rectum. An intrainestinal drain part being 2 - 2.8 m, a longitudinal intestinal wave died out not reaching the colon. Hence, from this moment the intrainestinal drain part did not enlarge and intubation of the proximal segments of the jejunum was accomplished mainly due to compression of earlier pleated bowels on the tube. Intubation was completed by olive introduction into the distal portion of the duodenum.

In table 3 the length of the drain part introduced into the intestine is compared with the length of the canine intestine, time spent on intubation, layer-by-layer extent of intubation-induced injury. As it is shown in the table the average length of the intestine amounts to 4 m, the depth of intubation - 2.4 m. Thus, the average deficiency of a drain in the intestine equaled about 1.6 m. Time spent on intubation ranged from 20 to 30 min. The average extent of traumatic changes in all layers of the intestinal wall virtually equals to the length of the intubated portion of the intestine.

The appearance of the intestine during the process of its palpatory intubation requires description (Fig. 11). The first minutes were accompanied by peristalsis activation, which to some extent hampered the procedure, though, following further drain introduction, peristalsis diminished and the intubated portion of the intestine became cyanotic.

During intubation hemorrhages and sometimes «windows» occurred in the mesentery. Intestinal bleeding especially easily developed in adult dogs. Intubation having been completed, the intestine, sprung on the drain, started to slip down from the internal end of the tube.

For visual assessment of the mucosa of the intubated intestine, it was opened by a longitudinal incision, animals having been killed by administration of aether into the pleural cavity. The content of the small intestine always revealed admixture of dark blood, it was absent only in the duodenum. Admixture of blood was observed in the drain, too;

Results of palpatory intestinal intubation.

Table 3.

№	Dog's name	Length of the intestine	Length of the introduced drain part	Intubation time	Extent of intubation injury in layers				
		(m)	(m)	(min)	m	s/m	m/c	m/l	ser
					(m)	(m)	(m)	(m)	(m)
1.	Bob	3.5	2.0	30	3.3	3.3	3.3	3.3	3.3
2.	Strong	4.1	2.7	30	3.9	3.9	3.9	3.9	3.9
3.	Dark	4.0	2.5	30	3.8	3.8	3.8	3.8	3.8
4.	Grey	4.15	2.3	24	4.0	4.0	4.0	4.0	4.0
5.	Novel	4.3	2.8	22	4.1	4.1	4.1	4.1	4.1
6.	Docktailed	3.5	2.1	25	3.3	3.3	3.3	3.3	3.3
7.	Pirat	4.1	2.0	30	3.9	3.9	3.6	3.9	3.9
8.	Shaggy	3.8	2.8	25	3.6	3.6	3.6	3.6	3.6
9.	Brown	4.1	2.9	22	3.9	3.9	3.9	3.9	3.9
10	Bobic	4.0	2.2	20	3.8	3.8	3.8	3.8	3.8

(Abbreviations: m - mucous, s/m - submucous, m/c - muscular circular, m/l - muscular longitudinal, ser - serous.)

intensity of its coloring with blood was greater near the internal end of the tube. After lavage the intestinal mucosa had a cyanotic coloring, spot-like hemorrhages and more extensive ones were occasionally revealed on it.

The basic method on investigating intestinal injury induced by intubation is a morphological one. For histologic examination of the small intestinal wall a 3 - 5 cm long portion of the intubated segment of the duodenum and at regular distanced from it three portions of the jejunum and the ileum of the equal size were removed.

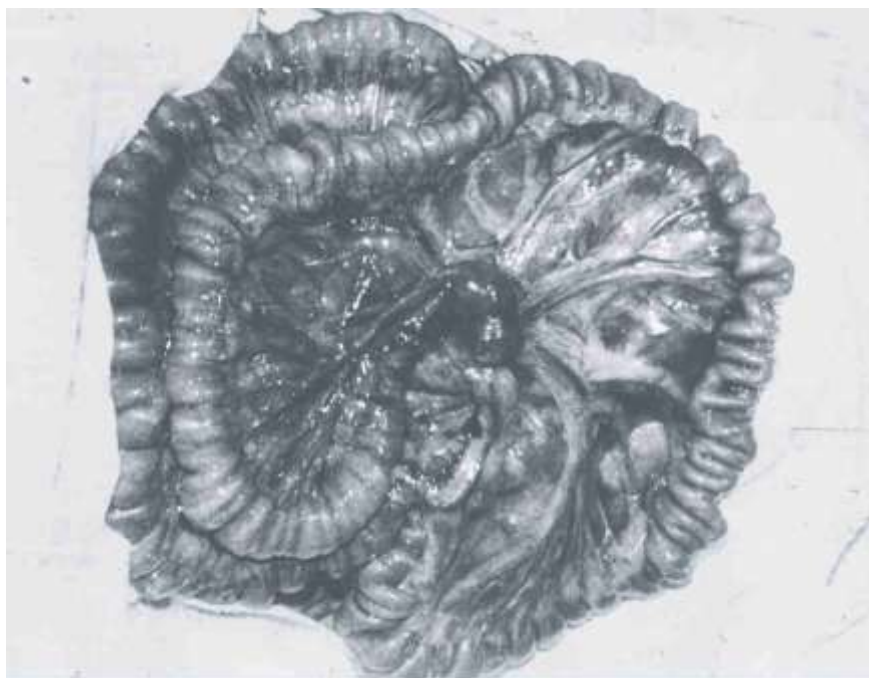


Fig.11. The canine intestine at the time of palpatory intubation

The colon was examined by a segment taken from its third proximal part. To assess tissue condition of a non-intubated bowel a sixth fragment was obtained from the proximal portion of the duodenum.

To prepare tissues for examination under a light microscope resected portions of the intestine were washed with a physiological solution and placed for fixation into a 10 % neutral solution of formalin for 24 - 48 hours. Fixation being over, a piece cut from an intestinal fragment was put in alcohol of increasing concentration and laid over with paraffin. 7 - 10 micron thick histological sections were obtained from paraffin blocks and stained with hematoxylin and eosin, azure 2 and eosin.

Microscopic examination of histological slides of the colon showed that structural changes in all layers of its wall were noticed in every dog. Ruptures of the mucosa with oozing of blood into the lumen of the bowel and hemorrhagic saturation of the mucosa near ruptures were observed. Focal hemorrhages into the mucosa without damaging its integrity were seen at some places. Oedema in the submucosa, plethora and stases of blood in vessels, abruption of the mucosa with the development of hematoma observed also macroscopically were found. Focal hemorrhages were also detected in muscular layers.

Tearing of the mucosa in the ileum were much deeper, hemorrhages and hematoma were more extensive. Lesions and abruption of epithelial lining of villi were noticed at some places. Focal hemorrhages in muscular layers of the ileum were present. Smooth muscular cells of both intestinal wall layers were in a state of dystrophy, some of their groups being ruptured and necrotized. Lesions of the submucous layer corresponded to its changes in the colon.

In the jejunum, abruption of the mucosa was revealed more rarely but hemorrhages, oedema of villi, dystrophic and necrotic changes of their epithelium were present. Oedema and stases in lymphatic vessels were seen in the submucosa. There were characteristic focal hemorrhages in muscular vessels.

Destruction of the mucosa, submucosa and serosa, focal hemorrhages in muscular layers were also found in the intubated portion of the duodenum.

Moderate oedema, plethora, stases in intramural vessels prevailed in the non-intubated portion of the duodenum.

Thus, wavy advancement of the intestine down a drain induces ruptures of the intestinal mucosa with blood getting into the lumen of the intestine. Due to the displacement of the mucosa and muscular layers in relation to the submucosa, ruptures of intramural blood vessels with the development of hematmata leading to local dissection of the intestinal wall are possible. In addition, palpation of the intestine and drain causes rupture of separate muscular fibers and is accompanied by microhemorrhages. Severity of lesions in the distal portions of the small intestine is slightly greater than in the proximal parts, which is due to more lengthy action on them during transanal intubation. Oedema, plethora and stases of blood in intramural vessels found in non-intubated sections of the intestine which could be attributed at the expense of intestinal eventration served as a background of the above mentioned lesions of the intestinal wall.

In sum total, experiments confirmed rather high sensibility of the intestine to palpation, gave a picture of its wall condition, clearly revealed the main cause of described in literature clinical complications of the palpatory method including: hemorrhages into the intestine, ulcerative enteritis, lengthy restoration of peristalsis, postoperative commisure ileus. Limited application of the method was proved: due to difficulties on introducing a drain that is proportional to the small intestine a segment of the bowel «slips» from its inner end and as a result is not emptied. Pressure of a tube on the part of the intestinal wall that is injured due to intubation can result in decubitus and perforation of the bowel.

2.3.3. ASSESSMENT OF RESILIENCE AND FLEXIBILITY OF TUBES

The necessity of the study is evoked by the menace of decubiti and perforation of the intestine due to tube action on the one hand and bending of tubes caused by the influence of the intestine on the other (Fig. 15).



Fig.15. A version of bending of an unresilient drain

Bending of a tube in hands reveals the increase of its resilience at the beginning and sharp fall afterwards. The decrease of tube resilience is the result of its deformation (bending) - local approaching of drain walls and thus closing of its channel. For objective assessment of different intestinal drains the author suggests to compare them as to their *maximum resilience* (resistance to bending) and *tube flexibility limit*. By the flexibility limit I imply the distance between two diametrically opposite tube bending points in a state of the maximum resilience. The perfect intestinal drain, for example, will have the resilience limit equal to its diameter. Thus, we will express the maximum tube resilience (resistance to bending) in force units, the flexibility limit in units of length.

The investigation of resilience and flexibility of tubular drains, was conducted at body temperature with a device specially designed by the author and called an elastometer.

To determine resistance to bending and flexibility limits four typical tubes were selected from table 1:

- a rubber tube (a gastric probe) with an external diameter of 10 mm and internal of 6 mm;
- a silicon tube with external diameter of 10mm and internal of 6mm;
- a polyvinylchlorid tube (prescription PM 42) with an external diameter of 6 mm and internal of 4 mm;
- a tube made of «food» polyethylene with low density and an eternal diameter of 5 mm and internal of 3.5 mm.

Three specimens of each tube were taken for examination. It is evident from combined graphs in Fig. 21 that resistance to bending (axis y) and the flexibility limit (axis x) in investigated tubes on average amount to: a rubber tube - 0.157 kgf and 35 mm; a silicone tube - 0.13 kgf and 40 mm; a polyvinylchloride tube - 0.13 kgf and 20 mm; a polyethylene tube - 0.6 kgf and 20 mm. Four five times difference of resilience of polyethylene tube as compared with the others reveals an insuperable contradiction of the method: facilitation of the palpatory intubation procedure, elimination of the threat of drain bending, safe shunting of bowels can be achieved only at the expense of more likely probability of decubiti and perforation occurrence.

It is difficult to exclude a case when an unsafe tube resilience (0.12 kgf) is perceived by 1 cm^2 of the small intestine. Even under favorable conditions it should be regarded that 0.12 kgf/cm^2 is a short-time physiological pressure produced by the small intestine, but a drain is to be left in it for some days and even more. A definite condition may occur in fixed intestinal flexures especially in the colon where the pressure limit on the wall is three times less than in the small intestine. Drain resilience must be in correlation with the patient's age, condition of the intestinal wall in case of peritonitis and ileus, severity of intubation-induced injury.

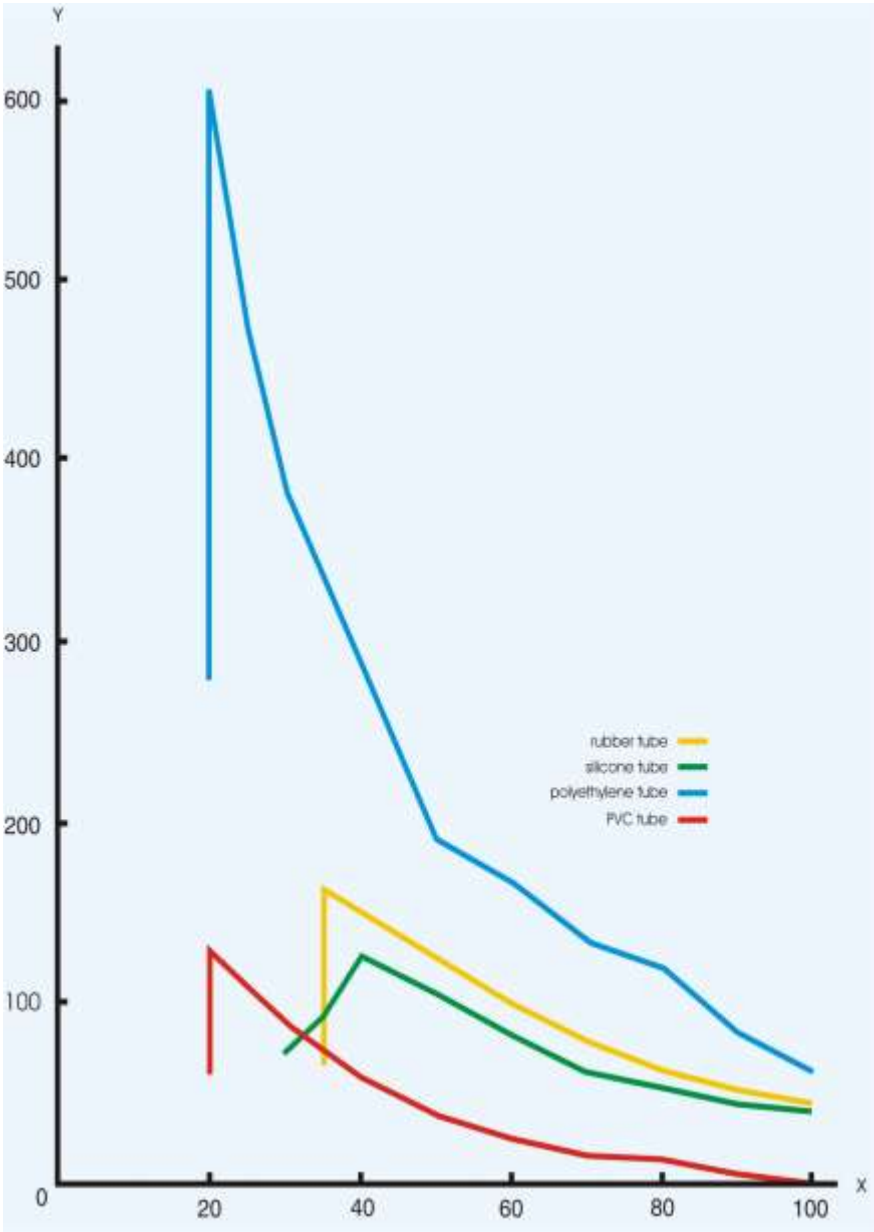


Fig. 21. Comparison of combined resilience curves of tubes made of rubber, silicone, polyvynylchloride, polyethylene

Taking into account a wide tube application for wounds, various body canals and cavities, investigation of tube resilience and flexibility is expedient for all branches of medicine. I consider that determination of corresponding indices and their publication by medicinal tube manufactures will become an accepted norm. Medicinal endoscope specification contains some number expressions of all their important characteristics except resilience and flexibility. Such subjective assessment of endoscopic tubes as flexible, resilient, stiff, rigid, soft are misleading and should be replaced by definite expressions of the resilience limit (resistance to bending) and the flexibility limit. The latter index would inform: bending of an endoscope with a lesser diameter could lead to its damage.

2.3.4. ASSESSMENT OF THE INJECTION METHOD FOR RECANALIZATION OF DRAIN AND IRRIGATION OF INTESTINE

When connecting a one-channel drain to vacuum a possibility is always present of chyme clog formation at an unknown to us level. A conventional technique for recanalization of a tube and decrease of chyme viscosity consists of fluid injection into a drain. The injection technique is used not only for recanalization of a drain but for washing (lavage) the intestinal mucosa as well: «The task of primary importance sanitation of the small and large bowels at the early postoperative period, is thus solved, but its solution results in prevention of the development of peritonitis in its terminal stage.» (V. I. Polyglotov, 1988).

Success in recanalization of a drain depends on its design. According to results reported in the current literature, side port size has diminished to 2 mm in diameter since 1977 but their total number has increased to 50 at the minimum. In 1983 a description of a drain with 26, in 1987 with 15 - 17 side holes was already given (table 1).

A survey, carried out among 10 surgeons at the First Riga Hospital to obtain data on motivation for a large number of ports in polyvinyl chloride drains utilized in the hospital, revealed lack of conception on this problem. In compliance with the existing view, drain manufactures were to be guided not by a number of side ports but by a distance between them - about 40 mm.

Considering a complexity of the theoretical and clinical determination of drain recanalization efficiency I decided to conduct a stand evaluation of the *intradrain injection* limit expressed in a number of washed out side ports.

The method has been tested on a polyvynylchloride drain identical to one applied in the clinic and used by the author in previous experiments. Its external diameter was 6 mm, internal 4 mm, ports with a diameter of 2 mm were situated at a distance of 40 mm from each other, the total number equaled 60.

Assessment of injection limit consecutively comprised:

- numbering of drain side ports starting from its outer end;
- placing of the drain within a container with 25 mm in diameter;
- water injection into the drain by means of a 100 ml syringe;
- recording of a side port number corresponding to the last stream (Fig. 22).

Each surgeon checked his own intradrain injection limit three times. Pressure on the cylinder and syringe piston was exerted by surgeon's habitual movements - either by one hand fingers or by both hands. Measurement results are shown in table 4.

Comparing results of table 4 with column 7 of table 1 it is easy to notice that our intradrain injection limit is close to the number of side ports in a drain manufactured by V. G. Dorofeev et al. (1987) and amounts to 15-17.

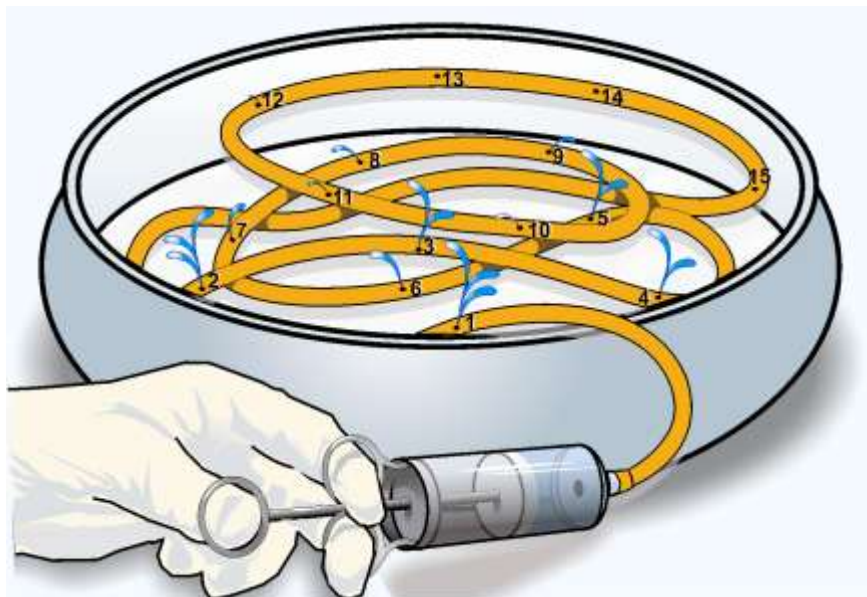


Fig.22. Illustration of estimation the intradrain injection limit

Measurement Results of the Intradrain Injection Limit.

Table 4.

№	Surgeon's initials	Intradrain injection limit (number of streams measurements)			The average of 3 measurements
		I	II	III	
1.	G. S. G.	18	17	18	17.67
2.	G. K. A.	15	16	14	15.0
3.	D. B. A.	19	18	19	18.67
4.	K. P. N.	12	13	13	12.67
5.	M. S. A.	17	15	15	15.67
6.	M. J. L.	10	14	14	12.67
7.	P. V. E.	12	12	14	12.67
8.	R. M. S.	18	16	15	16.33
9.	S. A. Tz.	18	18	20	18.67
10.	Sh. P. Tz.	11	12	13	12.0
	M±m				15.20±2.4

I consider that this criterion is essential for a specification of any drain. For example, if an internal diameter of a tube is 4 mm, a diameter of side holes of 2 mm, they are 40 mm apart, but the intradrain injection limit 15, then the drain recanalization depth and irrigation of the intestine is only 60 cm.

Supporting investigation of new techniques of the entire drain recanalization and irrigation of a corresponding portion of the intestine we must accentuate that the restriction of the side port number causes difficulties in emptying the intestinal content. In a drain with 15 side ports and the intrainestinal part being 3 m long, the distance between holes will increase to 20 cm but the way of the content to a drain channel correspondingly to 10 cm. Refraining from further comment I will only note that V. I. Polyglotov (1988) for lavage of the intestinal cavity by means of a drain with holes set at 20 cm apart applied vacuum of 0.2 - 0.8 kgf/cm² G. Kormann, Ch. Wuttke (1983) applying a drain with holes at 11- 12 cm apart applied much lower pressure within it - 0.05 kgf/cm².

If it can be debated * its action on intestinal tissues is discussed in pages 120, 121 that vacuum of 0.2 - 0.8 kgf/cm² is harmless, water injection into the small intestine is a safe procedure: with all surgeons the height of a proximal stream from the drain did not exceed 1.2 m; the height of other distal fountains was falling as they were more distant from the syringe. It is a clear example that water pressure at drain side ports is less than 1.2 m. That corresponds to the pressure limit on the small intestine (0.12 kgf/cm²).

- *its action on intestinal tissues is discussed in pages 118, 119*

- Chapter 4

THE STUDY ON INTESTINAL INTUBATION

The author has not come across any works attempting to summarize and to raise a problem of intestinal intubation above separate tasks of the abdominal surgery, endoscopy, gastroenterology. Safe, effective application of conventional intestinal intubation, methods, elaboration and examination of new ones, I think, call for a solution of the following interrelated problems: classification, finding of common regularities and description of particular mechanisms of intestinal intubation, formulation of the prospect conception. In review of «Problems» I have differentiated techniques, procedures, methods of tube introduction into the intestine according to their implementation force. Concluding an attempt to solve the first task I give a classification including five independent methods of intestinal intubation:

- method of pneumatic intubation;
- method of manual extubation*;
- method of manual intubation;
- method of palpatory intubation;
- method of functional intubation.

Common regularities revealed at investigating mechanisms of the above mentioned methods have been systematized *in four tenets of the study on intestinal intubation*. The first tenet of the study on intestinal intubation is formulated by the author as follows: *the main obstacle to intubation of the intestine lies in its loops; second intubation by straightening mobile portions of the intestine is a contradictory one*. The third and fourth tenets of the study will be presented after discussion of these two theses.

* *The method is used not only for withdrawal of tubes from the intestine but their introduction as well (see 2.4.2)*

2.4.1. MECHANISM OF THE METHOD OF PNEUMATIC INTUBATION

The pneumatic method is implemented by one force localized at the place of unfolding of the *invaginator*.* Unlike other methods, this one envisages repetition of the intestinal curves: the internal (uneverted) part of the invaginator advances along a lesser radius of its distended external portion lining the bowel mucosa. Thereupon, pneumatic intubation can be analyzed using the *formula*

$$\frac{Q_1}{Q_2} = e^{\alpha f}$$

1

deduced by L. Aler in 1765 for a rope wound on a bitts and holding a ship (Fig. 23). This formula explains all difficulties of intestinal intubation.

In relation to pneumatic intubation (Fig. 24) Q_1 is an *vanguard* intubation force produced by unfolding of the invaginator. The value Q_1 depends on physico-mechanical specifications of the invaginator, a diameter of its external part, air pressure produced within it. Q_2 is a residual force from Q_1 manifesting itself at the level of a chamber neck by pulling out from it the internal part of the invaginator, e - the basis of natural logarithm, f - a friction index between external and internal parts of the invaginator, α - an angle of their common bendings.

Values e, f - const., the value Q_1 is also const. Assuming $\alpha=0$ that is in case of a straight-line configuration of the invaginator, $Q_1=Q_2$, when α is increasing Q_2 begins sharply decrease; on α reaching a definite amount Q_2 is equal to naught and as the result the movement of the inner part of the invaginator is stopped.

* according to function a thin-walled unfolding tube of A. A. Zjabbarov's device is an *invaginator* (an *introducer*) of a *diagnostic* or *curative tube*

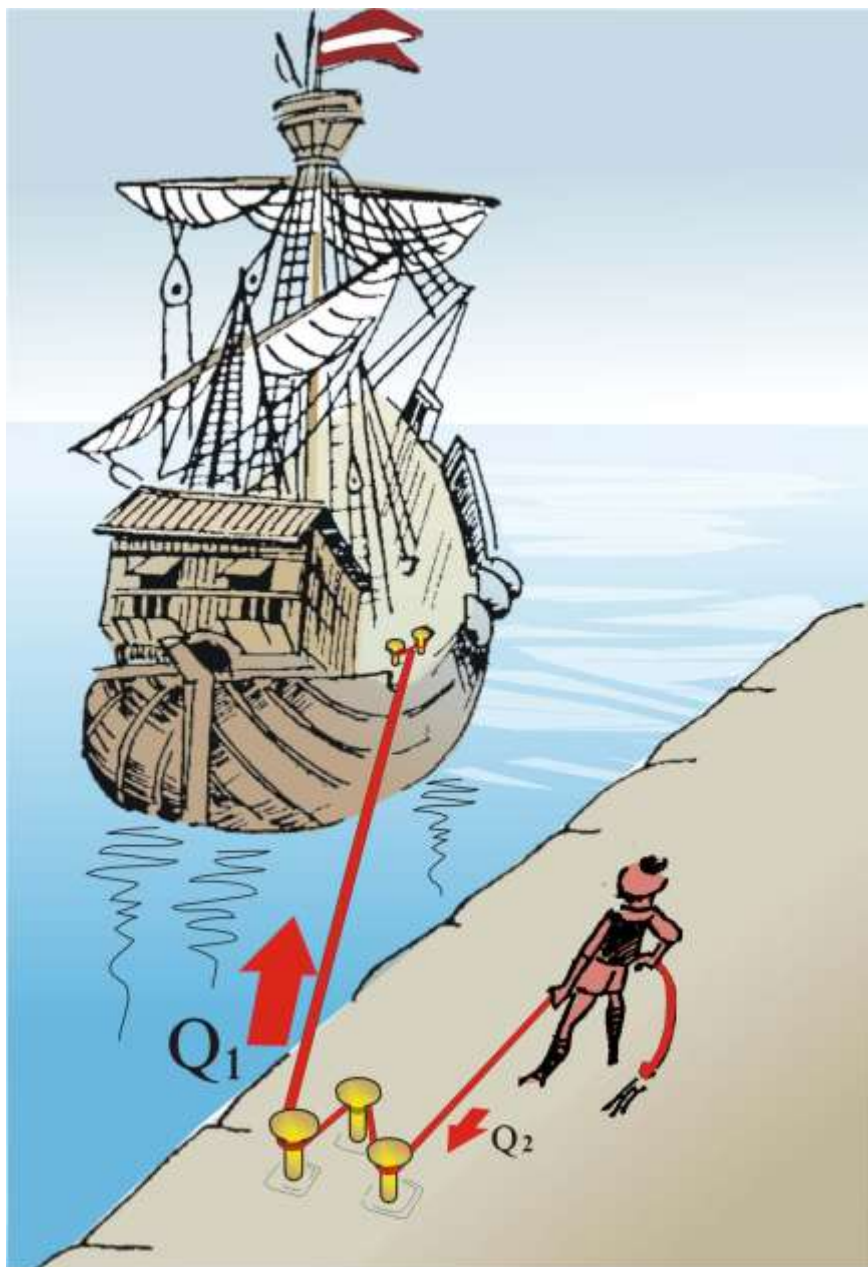


Fig.23. Illustration to formula by Aler $Q_1/Q_2=e^{af}$: a bitts and small effort are sufficient to neutralize the residual force Q_2 and to stop the ship

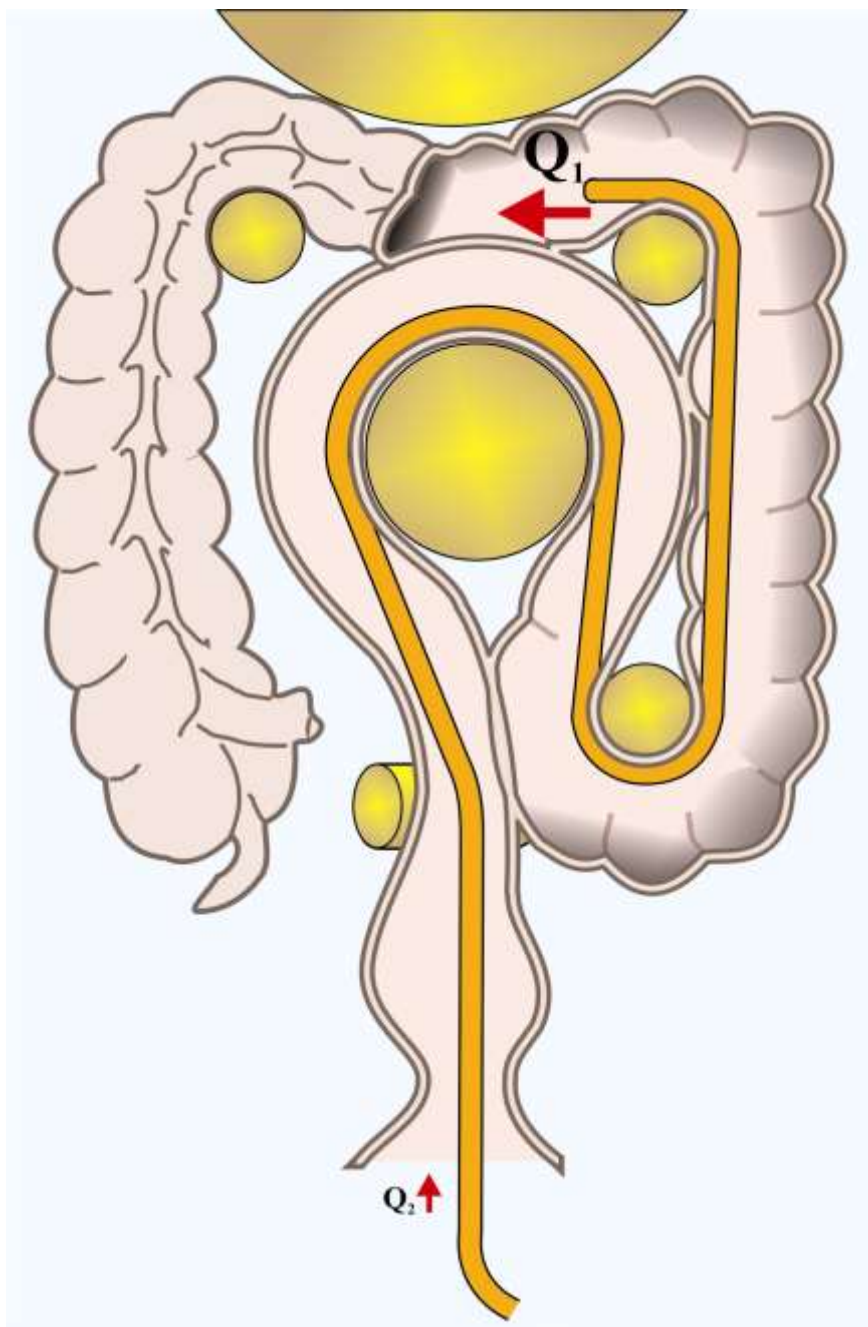


Fig.24. "Bits" of the colon, hampering the movement of uneverted part of invaginator

2.4.2. MECHANISM OF THE METHOD OF MANUAL EXTUBATION

The method of two-stage intestinal intubation by the “rope-way” is in fact a consecutive application of the methods of functional intubation and manual extubation. The mono-rail technique is also performed in two steps: the method of functional intubation secures the first step; the second step is the integration of the methods of manual extubation and manual intubation.

The force realizing both manual extubation and manual intubation is of the same origin, a principal difference between the methods lies in localization of force on a tube in relation to an object to which it advances. For example, at colonoscopy *verte*. Thus, the force of the palpatory intubation method as to its localization is a *rearguard one*. On intestinal extubation, localization of the force and the object receiving the tube actually coincide, therefore the force of the manual extubation method as well as of the pneumatic method is an advanced one.

At long tube extraction, the intestine, from the place of its mobile portion near the intubated orifice of the tract, straightens on the tube. The effect can be explained by the Aler formula and anatomy of the intestine: the angle of common flexures of the intestine and the tube combines them to such a degree that a tube movement independent from the bowel is completely impossible for any amount of Q_I force. Movement of intestinal loops carried along by the tube stops the fixed portion of the tract what is nearest to the intubated orifice. At first straightening the intestinal loops promotes extubation but as the straightened portion of the intestine increases in length and density, it, with the tube contained, begins to shape into conglomeration (Fig. 25).

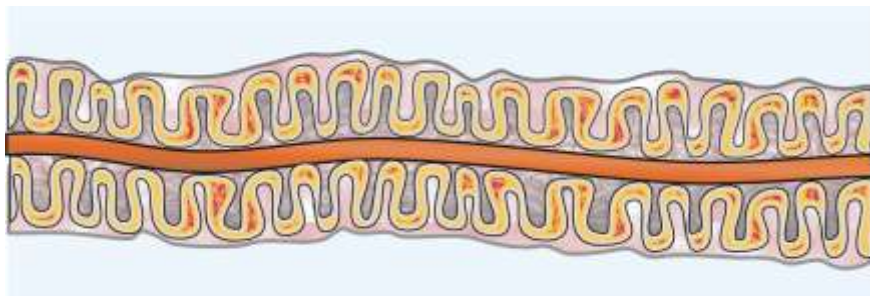


Fig. 25. A schematic sketch of conglomeration of the straightened portion of the intestine and the tube

Thus, up to a certain moment, tube extubation is accomplished only due to straightening the intestine, that is without displacement of the tube internal end along the mucosa; this, as a matter of fact, represents «extubation without extubation». The turning point of extubation is manifested by completion of straightening the intestine on a small portion of a tube and the moment slipping of loops down its inner end sets in.

The manual extubation method completes the “rope-way”: by removal of the guide from one natural orifice, first, straightening the intestine is negotiated with the following drawing of the endoscope in tow into the opposite orifice of the tract (Fig. 26).

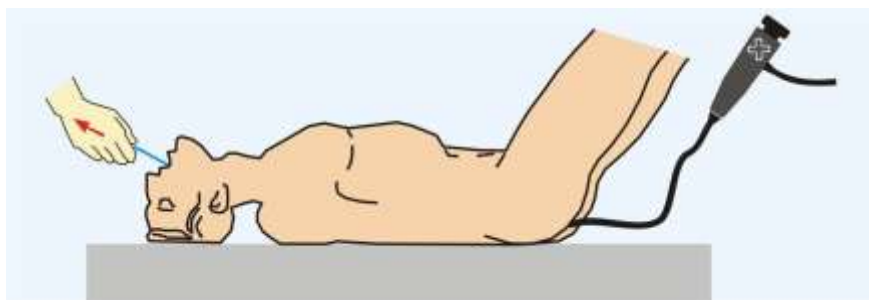


Fig.26. The method of manual extubation of the intestine completes intubation by the “rope-way”

At intestinoscopy using the “monorail”, the method of manual extubation secures straightening the intestine and tension of guide ends; an endoscope sliding along the monorail is inserted into the tract by applying the method of manual intubation (Fig. 27).



Fig.27. The author's interpretation of forces interaction at the second stage of the “monorail”: the manual intubation method is integrated with the method of manual extubation

Taking into account a contradictory character of straightening the intestine, the limit set to its straightening, intubation by the “rope-way” method (Fig 28) requires a definite manual force which, certainly, exceeds the pressure limit on the intestine. A large amount of force is also signified by the necessity «to bougie» conglomeration of the straightened intestine, which is narrowed to the guide diameter, with an endoscope.

The reported cases of balloon breaking and leakage of mercury into the intestine on withdrawal of a Cantor tube are also characteristic of the mechanism of the method. Breakages can be explained by the difference between diameters of the balloon and the tube, straightening the intestine and its narrowing to the tube diameter.

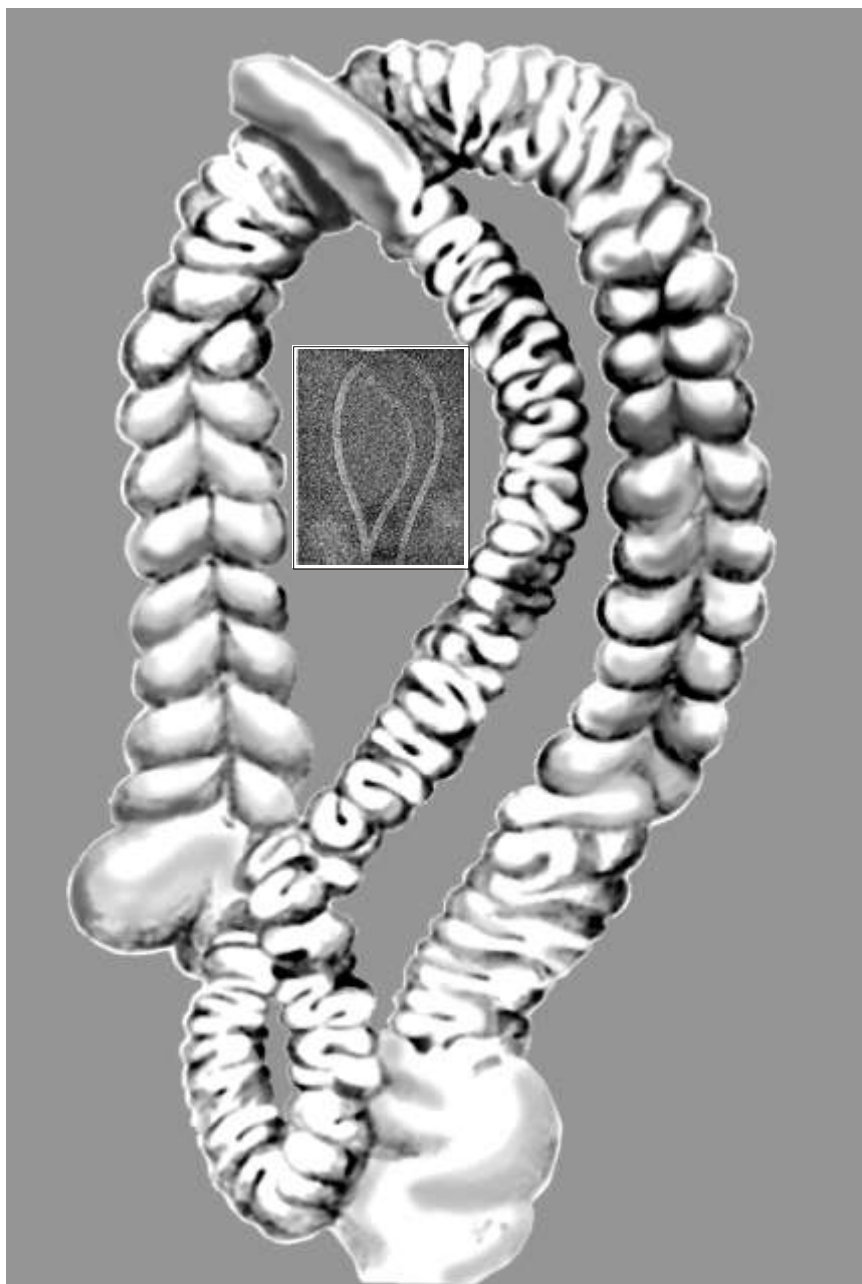


Fig.28. The intestine following intubation by the "rope-way". The author's graphic reconstruction of a roentgenogram (in the center and on the Fig. 6), taken from the article by K.Kawai, M.Tada (1982)

2.4.3. MECHANISMS OF THE METHOD OF MANUAL INTUBATION

It has been already emphasized that in order to classify methods and techniques of intestinal intubation involving manual force it is necessary to determine its localization on a tube. The method of manual intubation is implemented by a rearguard force. It starts with a conventional pushing of a tube into the colon. The efficacy of this manual intubation technique has not improved significantly during the last eight decades: transoral navigation of an endoscope with a controllable distal tip secured intubation of less than $\frac{1}{4}$ of the small intestine. Low results of the initial technique of the manual intubation method are explained by the necessity of a tube to repeat intestinal curvatures (Fig 29).

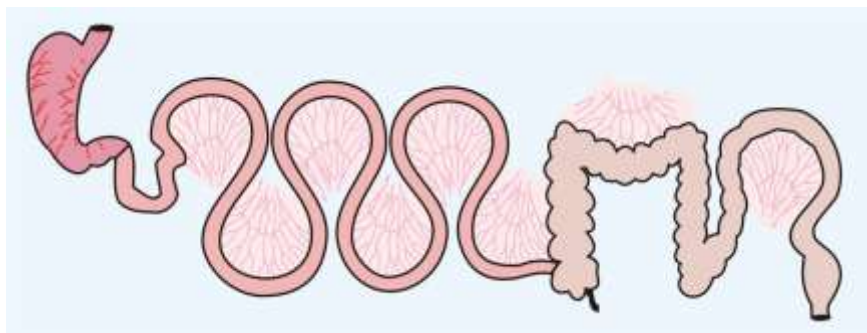


Fig.29. The intestine unfolded in one plane, - an illustration to the first tenet of the study on intestinal intubation

The second technique of the manual intubation method that is accomplished by straightening mobile portions of the intestine is used for examination of the colon (Fig. 30).

The second tenet of the study deals with the limit and difficulties of this technique: intubation of the intestine by straightening its mobile parts is discrepant. To examine $\frac{3}{4}$ of the small intestine V. P. Strekalovsky et al.

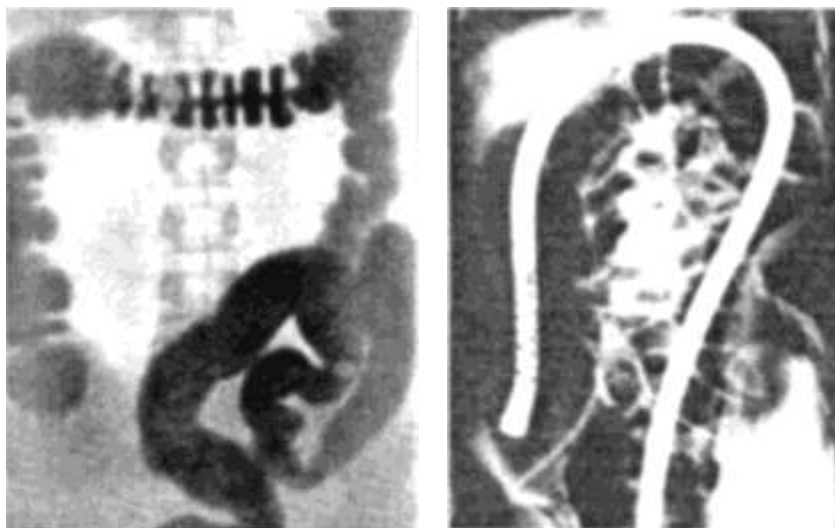


Fig.30. Compare the roentgenograms: on introducing the colonoscope the natural curvatures of the colon shorten ten times*

(1986) had to apply general anaesthesia and roentgenological control. This «switching off» of the patient, I consider, permitted the authors to keep the straightened part of the small intestine on the endoscope. Considerable anatomical differences between the large and small bowels (a large diameter, short length of mobile segments the sigmoid and transverse colons, their location between fixed segments) smooth away a negative aspect of the contradictory effect of straightening the intestine at colonoscopy. I think that, while undertaking endoscopy of the small intestine under general anaesthesia according to Strekalovsky, hands of an assistant must hold a portion of the small intestine, previously pleated on a tube, through the anterior abdominal wall, i. e. they perform a function of fixed segments of the colon at colonoscopy. But due to a small diameter of the small intestine conglomerate formation of it and an endoscope occurs more intensely than during colonoscopy.

* A roentgenogram of an endoscope and proximal $\frac{3}{4}$ of the small intestine straightened on it arises some interest but it is not published by V.P. Strekalovsky e al. (1986)

Proceeding from damages to the colon induced by colonoscopy, the amount of force which impedes the advancement of a colonoscope is not only collated with the physiological pressure limit over the bowel (0.04 kg/cm^2) but exceeds its wall strength as well. A rear-guard localization of the manual force permits to conclude that injury to the intestinal wall are more frequent not due to its perforation by a colonoscope end but by stretching of segments near an intubated tract orifice, for example, the sigmoid colon.

2.4.4. MECHANISM OF THE METHOD OF PALPATORY INTUBATION

Introduction of a drain through an ileostoma is considered to be the least labour-consuming and injury inducing procedure among all palpatory intubation variants because other variants of the method require traverse of a tube through fixed segments of the intestine enclosing the mobile ileum-jejunum from both ends.

A mechanism of the palpatory method is, as a matter of fact, straightening the intestine by a single longitudinal wave repeated several times. The force implementing the method can be classified as a *transit one*, i. e. moving from one end of a tube to another. Due to bowel movement along a tube in a single wave, the nearest, for example, to an ileostoma a 15 cm long segment of the small intestine, its mobile portion being 375 cm, is subjected to palpatory action at least 25 times, a segment situated proximally from it is palpated 24 times and so on.

It seems that straightening the small intestine by a single wave must secure introduction into it of a proportionate tube, however, palpatory intubation of the intestine in the experiment proved that the average deficiency of the drain amounted to 1.6 m. I think that this is mainly due to: response of intestinal muscles to palpation, in addition, gloves that in

contact with the surface of the intestine become slippery and thus even energetic physical efforts do not secure conduction of a sufficient wave along the tube.

A wide force range of surgeon's fingers, an emotional factor manifested at its competition with a force impeding tube advancement allows us to consider *palpatory and both manual methods as subjective ones. A common feature of subjective methods is their problematic character* which mainly reveals itself by injury and insufficient depth of tube introduction.

All three subjective methods as well as the pneumatic one according to A.A. Zjabbarov are *single-force* methods. Comparison of forces and demerits of these four methods enables us to draw the following conclusion: *intestinal intubation applying a single force, irrespective of its amount and implementation mechanism has a problematic character.*

2.4.5. MECHANISM OF THE METHOD OF FUNCTIONAL INTUBATION

It is possible to assess the amount of efforts on functional intestinal intubation by the level of the physiological intrainestinal pressure. E. B. Babsky, A.M.Sorin, S.N.Davydov (1975) provided data that the pressure within the small intestine, measured with the help of a radiocapsule advanced by it, did not usually exceed 40 cm of w. c. but could reach 80 and even 100 - 120 cm of w. c. When the radiocapsule was approaching the place of passage of the ileum into the colon the authors noted a gradual decrease of pressure down to the atmospheric and even negative one. In the ileocecal area the radiocapsule was delayed for several hours. In the colon the pressure was low; the amplitude of individual oscillations reached 40 cm of w. c.

Thus, the physiological pressure of the small intestine on the «leading» balloon of a Miller-Abbot or Cantor tube can reach 0.12 kgf/cm² but of the colon - 0.04 kgf/cm². If the area of bowel action on the balloon is 10 cm² then the maximum advance-guard force amounts correspondingly to 1.2 and 0.4 kgf. Investigation of the mechanism of the functional method I have begin with checking a version of the «leading» balloon.

As it follows from the first regularity of the study on intestinal intubation based on the formula by L. Aler $Q_1/Q_2=e^{\alpha f}$, the force Q_2 localized at the outlet from the stomach being a residual one from the advance-guard force Q_1 (localized at a balloon) will weaken to some extent already after a probe tube repeats the configuration of the duodenum. As the tube advanced into the intestine the increase of value α must reduce the residual force Q_2 to nought and thus lead to inhibition of intubation.

Intubation of the entire intestine with the «leading» balloon is impossible also in case the mechanism of the functional method is based on straightening the bowels. A. A. Beljaev (1962) described the straightened condition of the small intestine during functional intubation: «At laparatomy we examined the probe introduced before the operation. The intestine is as if threaded on the rubber probe which straightens separate loops of the small intestine in one tube providing favorable conditions for evacuation of the content». The described state of the small intestine may be attributed on the account of its peristaltic movements, but I am inclined to consider it to be due to manual drawing of the probe undertaken when it stopped (Fig. 31).



Fig. 31. The method of functional intubation: straightening the small intestine using probe manual extubation

Practical confirmation that the second tenet of the study is true and a whole intubation of the straightened intestine only with the «leading» balloon is impossible - difficulties and complications of the manual extubation method having one advance-guard force which potential is though many times higher than 1.2 kgf.

To explain the so-called total functional intubation of the intestine at least one additional intubation force should be introduced into its mechanism. My conception of two-or-multi forced mechanism of the method is based on an assertion that stimulation of intestinal peristalsis is caused not only by the heavy or voluminous balloon but also by the tube it continuing as well. As a result of this a tube coil in the stomach due to its contractions can advance to the duodenum and under the influence of a peristaltic intestinal wave develop into a spiral-like wave of a tube (Fig. 32).

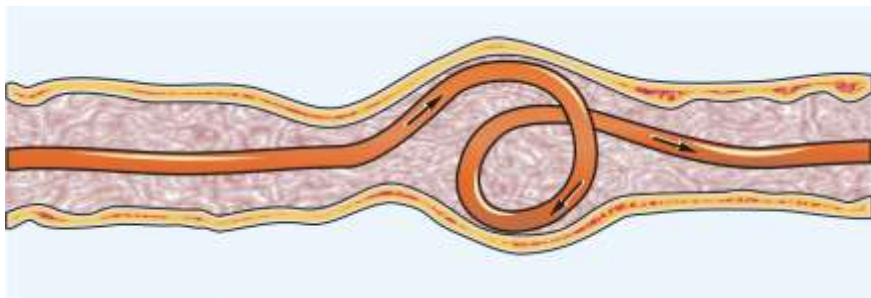


Fig. 32. The method of functional intubation: a version of transit force realization

According to localization this additional force of the functional method is a *transit one*. It occurs on condition that a tube with the least resilience is used. This quality of Miller-Abbott and Cantor tubes and existence of transit forces are manifested in their knotting at intubation.

According to my calculation, the advance-guard force in the colon can amount to 0.4 kgf. I think it can be increased by enlarging the area of a balloon after its stripping from the small intestine. But the main reason for extremely long duration of the functional method consists in the following - difficulties of a tube's spiral-line movement, short-term combined action of transit and advance-guard forces during intubation.

Hence, the conclusion about limited possibilities of single-force methods was expanded and transformed itself into the third tenet of the study: *intubation of the intestine applying a single force or diverse forces - is of a problematic character.*

2.4.6. FOURTH THESIS OF THE STUDY OR THE CONCEPT OF THE PROSPECT

The pressure limit on the intestine, synergy of intubation forces, the advance-guard position of one of them* - these are the key demands of my conception of successful intestinal intubation.

The first demand of the conception I have argued when assessing surgeon's palpatory force and examining intestinal injury due to intubation.

The essential importance of the advance-guard force is illustrated by comparing efficacy between the method of manual extubation and manual intubation: under similar force potential the former permits, more

** from Greek synergia - working together*

or less, passage of the entire intestine, the latter (implemented by the advance-guard force) only $\frac{3}{4}$ of the small intestine at best.

The method of manual extubation meets only one of three demands of the conception. To observe the pressure limit and synergy of forces two techniques of drain with drawal can be outlined: the mechanico-pneumatic (tube extubation accompanied by inflation of the intestine (Fig. 33) and the mechanico-functional technique (tube extraction against the background of extubation activity of intestinal peristalsis). Both new extubation techniques in contrast to a conventional one imply application not of subjective manual extubation force but strictly dosed mechanical one. Proceeding from the diameters of two main segments of the intestine and their pressure limits, the safe mechanical extubation force according to my estimation must be about 1 kgf.

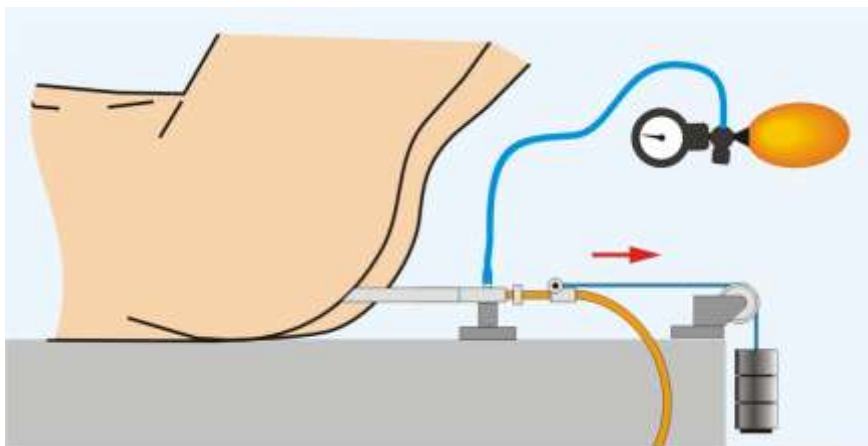


Fig. 33. A sketch of the mechanico-pneumatic extubation method

On using the first new extubation technique the safe air pressure fed into the intestine will add one more force to the advance-guard one which will prevent threading of the intestine on a tube.

The second new technique of intestinal extubation is exceptionally isoperistaltic one. Due to poor synergy between functional forces and constantly active mechanical force, the mechanico-functional technique will last longer than the first one but is undoubtedly safer than the manual method.

There is one more illustration of applying the concept of the prospect. The effectiveness of the method of functional intubation I suggest to increase by using a tube with recurring widenings (Fig. 34), which will replace unreliable transit forces on the *intermediate* ones, analogous by origin to the vanguard force, created by the intestine under the action of a Miller-Abbott probe's balloon. For the synergy of intermediate forces there should be a definite distance between tube's widenings.

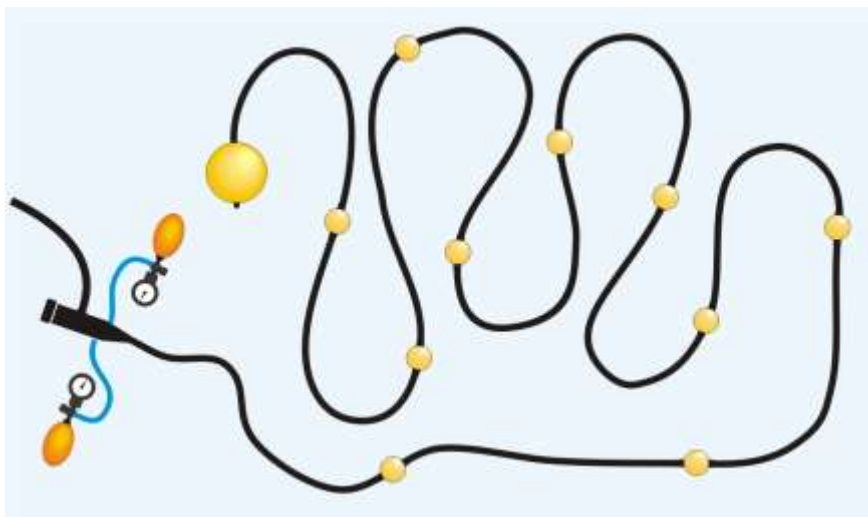


Fig. 34. The recurring tube's widenings must, I suppose, to ensure the synergy of functional intubation.

The attempt of realization of concept of the prospect in the “Colonoscope for family doctors” and the “Intestinal intubator with drainage” is expounded in the third part of this work.

Part Three

PROSPECTS

At present one of the urgent problems of practical medicine is to find alternatives to the manual and palpatory methods. The method of manual intestinal intubation does not ensure examination of proximal portions of the colon in all cases; the jejunum and ileum for endoscopists are practically «terra incognita». In addition, manual colonoscopy is badly tolerated by patients and inaccessible to the majority of practitioners.

Inevitable injury induced by intraoperational introduction of drains, their insufficient flexibility and considerable resilience, difficulties in their transanal introduction into the small intestine - are the main demerits of the palpatory intubation method.

My method of finding alternatives to the manual and palpatory methods can be jokingly formulated in brief: divide and rule over. The first steps towards a novel accessible to all diagnostic endoscope have been made due to selection of the primary function out of a number of endoscope functions - the one that ensures introduction of an endoscopic tube. Three more functions besides a transport one can be singled out from the palpatory method: evacuation, irrigation and splinting.

Thus, the task of primary importance in finding both alternatives is elaboration of *the transport function*.

The complete dependence on the condition of intestinal peristalsis is characteristic of my variant of functional intubation, too (Fig. 34). Its application for practical endoscopy and abdominal surgery is also inconvenient because of the necessity to introduce a tube by mouth.

Manual colonoscopes having been developed in 70-s, further investigation of roentgenological and applicatory means for tumour diagnosis of the colon suggested by A. A. Zjabbarov was senseless, however, «water was poured out with a child». An analysis of pneumatic intubation has revealed a principle possibility to meet all three demands for my conception of the prospect:

- rolling out of the invaginator in proportion to the intestine along the intestinal mucosa is to secure atraumatic intubation;
- the pneumatic method has the advance-guard intubation force;
- a canal of a dilated external part of the invaginator can be used for implementation of additional intubation forces as maximum in number as possible, but an inserted tube is to be of minimum resilience. For synergy of pneumatic and additional intubation forces there should be a definite distance between points of their application.

**A SURVEY OF SEARCH OF
THE COLONOSCOPE FOR FAMILY DOCTORS**

Designing of new endoscopes requires objects for their testing. Lack of adequate biological and stand models of the human colon makes their examination a difficult procedure and is the reason why «crude» devices and methods are tested on patients. Dogs do not suit the investigators of new colonoscopes: rigidity of joints and difficulties with evacuation of the colon prevents from experimenting on human cadavers. Known models of the intestine mainly used for teaching aims also exclude the effect of peristalsis and sphincters of the colon on the tube introduced.

Taking into consideration that application on patients of curative and diagnostic means without official approval is banned, I carried out on volunteers control testing of new systems of intubation. In 1976 - 1977 four men underwent intubation (V. L. S., V. V. T., A. A. M., S. A. M.), during the next 10 years the last of them, which made analysis of results easier as they were obtained under the same anatomical and similar physiological conditions, besides, it permitted to assess painfulness of a new intubation in dynamics.

At the end my search of a new colonoscope was reduced to the study of different variants of positioning an endoscopic tube and an invaginator.* My errors in the process of this investigation appeared to be «foresighted» - 10 years later they were repeated by other investigators as well. So an invaginator of my device applied for on June 18, 1973 resembles a thin-walled sheath folded in layers with a tube to be transported into the intestine placed in the center of it (Fig. 35). Such

* *Considering their interrelation «The Colonoscope for Family Doctors» could be also named «Intestinal Intubator with the Endoscope».*

multi-layer folding of the invaginator was supposed to secure a permanent contact of the tube's distal end (the objective) with the bowel. However, because of an inconsequent unfolding of layers revealed during stand testing of the device this variant of laying the invaginator I considered as lacking prospective.

Inconsequent unfolding of layers of the invaginator in my approach as well as in a technical solution patented in Germany (Fig. 36) is due to their «sticking» under the action of air pressure and its inevitable getting into one of the spaces between layers on folding. Untimely eversion of one of the layers excludes the others, situated above the everted one, from taking part in intubation.

In 1975 having failed with the multi-layer invaginator, to investigate variants of a one-layer instrument, I resumed my work with a device identical (as it was established by the end of 1976)* to the one manufactured by A.A.Zjabbarov.

The analogue of Zjabbarov's device was first tested on 23.02.76 (Fig 37 a, b). The invaginator was a polyvinylchloride sheath (model PM-42) with the nominal diameter of 20.0 mm and a wall of 0.15 mm thick. The «cauda» of the invaginator was hermetically attached to a portion of the rubber duodenal probe, an external diameter of 6 mm, by means of a metal olive. Pressure within the chamber and outer part of the invaginator during intubation did not exceed 0.25 kg/cm². The procedure of the colon intubation was painful and of long duration especially the passage of its acute-angled flexures. It seems that retrograde introduction of the invaginator was hampered not only by flexures but their limiting sphincters as well (Fig. 38). To facilitate intubation the colon was insufflated and palpated.

** in this year I got to know that my device has prototypes.*

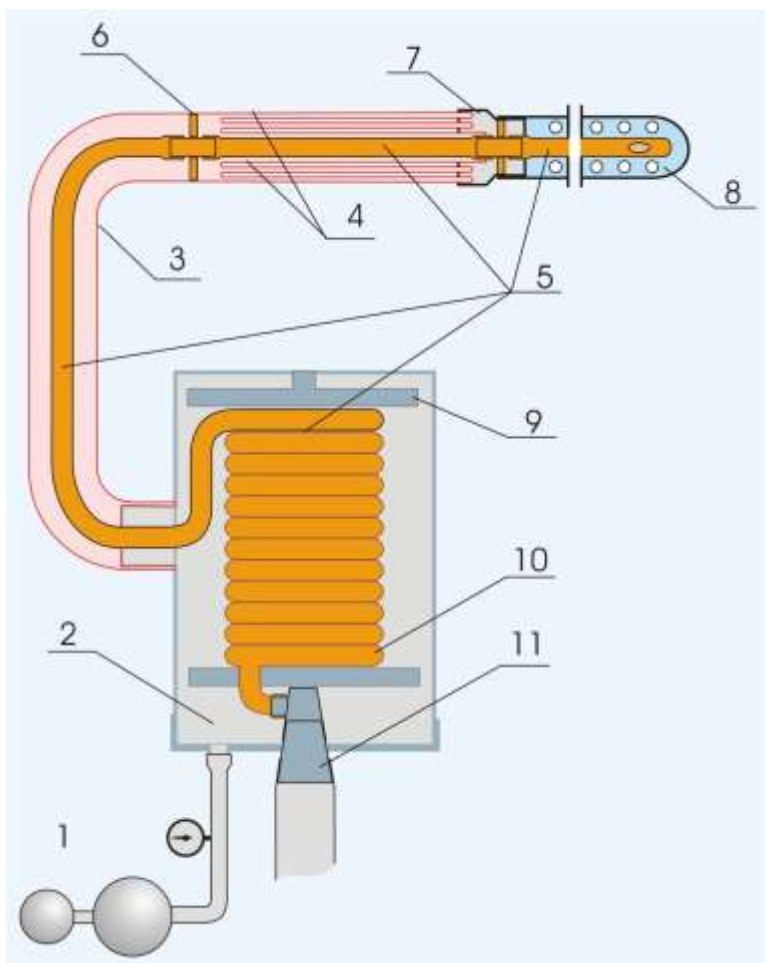


Fig. 35. Graphic sketch of my application for the device № 1933784/28-13 on 18.06.73.

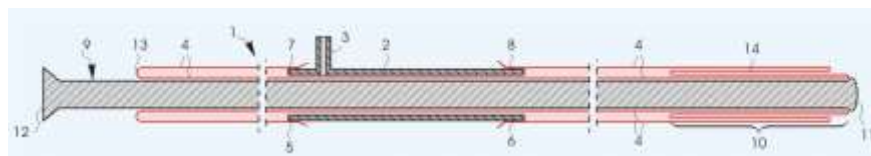


Fig. 36. Graphic sketch of the German patent № 3329176 (Inventors: Kramann, Bernhard, application for the device on 28.06.83)



Fig. 37 a. Testing of the pneumatic method when the invaginator and the tube are in a consecutive connection. (23.02.76. The Second Riga Hospital, M.S.A. 33 y)

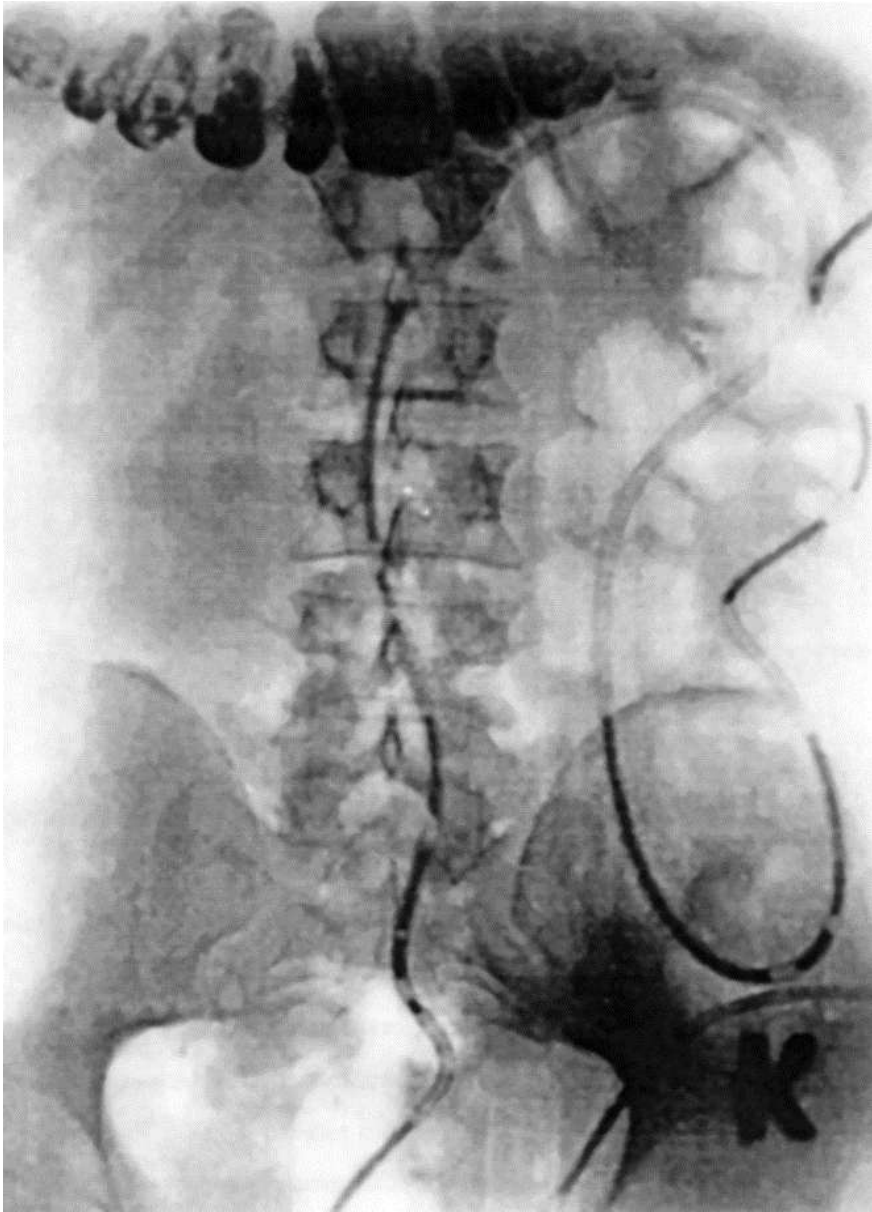


Fig. 37 b. Testing of the pneumatic method when the invaginator and the tube are in a consecutive connection. (23.02.76. The Second Riga Hospital, M.S.A. 33 y)

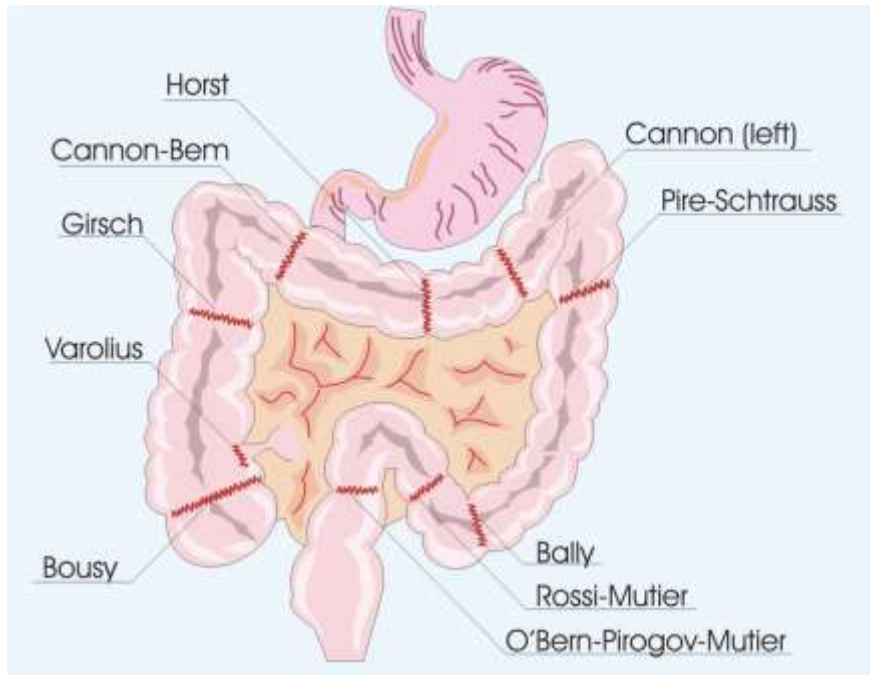


Fig. 38. Physiological sphincters of the colon

The device, manufactured by A. A. Zjabbarov, with one of the variants of connecting the invaginator and the tube, defined by me as a consecutive one (Fig. 39), does not suit to intestinal endoscopy because of two basic reasons: the endoscopic tube's objective can come into contact with the bowel only following complete eversion of the invaginator; prolongation of the invaginator with the tube secures progressive increase of the value ... that quickly reduces the residual force Q_2 to zero.

A *parallel* type of elements connection (Fig. 40) also excludes the movement of the endoscopic tube's objective along the intestinal mucosa, but, due to a progressive drop of the value after half of the invaginator has been everted, it was considered to be indispensable for the «Intestinal Intubator with the Drain».

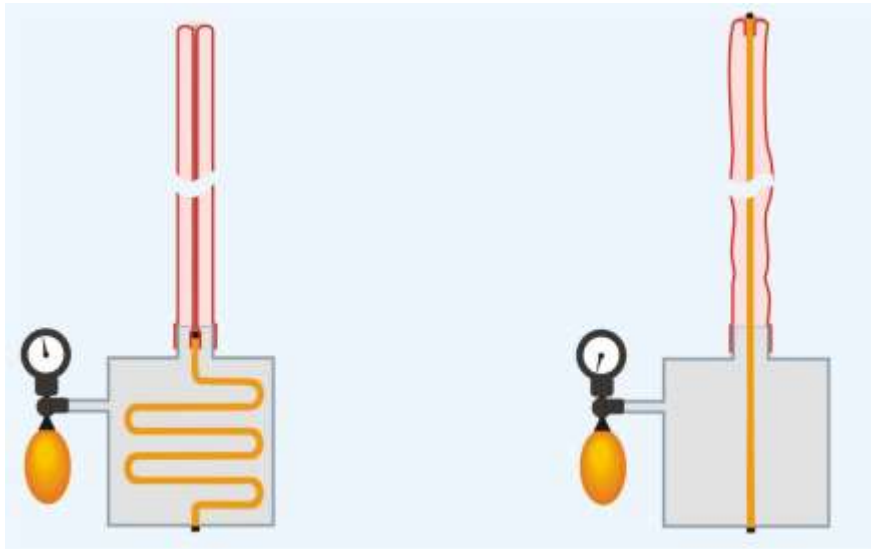


Fig. 39. A consecutive connection of the invaginator and the tube: the condition during (left) and after (right) intubation

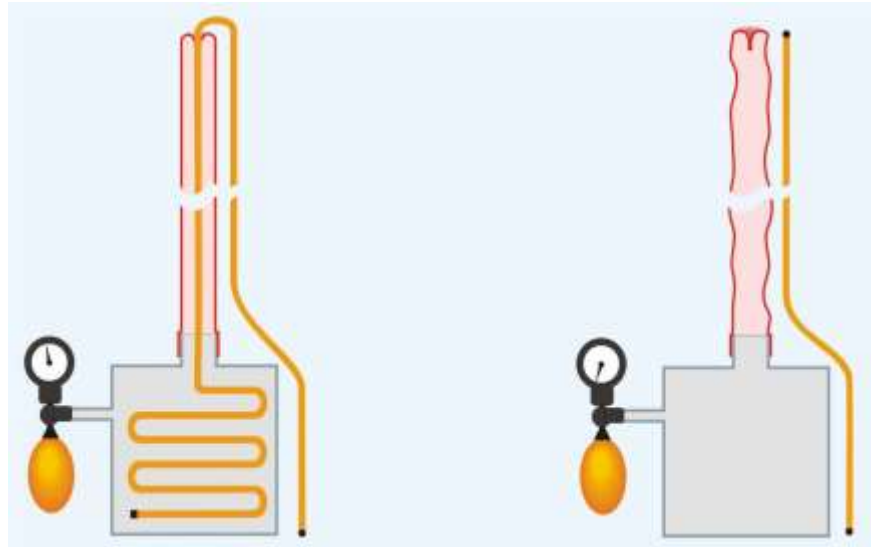


Fig. 40. A parallel connection of the invaginator and the tube: the condition during (left) and after (right) intubation

The roentgenogram made at the time of testing the parallel variant of the pneumatic method (Fig. 41) reveals, though not very clearly, the position of the tip of a little contrast tube with the diameter of 4 mm in the distal portion of the ascending colon. During two following tests of this variant the end of the inflated invaginator was palpated in the cecum. Administration of spasmolitics shortened the time of three tests and simultaneously abated stomachaches accompanying intubation. However, during the fourth test rupture of the invaginator took place.* The study of causes which led to rupture revealed that the polyvinylchloride invaginator under the pressure of 0.25 kgf/cm^2 within it and temperatures at $37^{\circ}\text{--}39^{\circ}$, enlarges in the diameter, i. e. becomes thinner. Later, any pains accompanying intubation I started explaining by extension of the intestinal wall.

Assessing devices with the parallel variant of the method one should remember that under the influence of air pressure the inner part of the invaginator literally sticks to the tube within it. Thus, the inner parts of the tube and the invaginator advance with the same speed. The matter is different as regards their outer parts: it follows from the sketch on Fig. 40 that the speed of their introduction into the intestine is also 1:1; if the tube is not backfolded but is left with its objective looking forward then the ratio amounts to 2:1 - the tube advances into the intestine twice as fast as the invaginator.

In the light of this, it is clear why Stephen, B. Leighton and William H. Boyd (1981) having applied for an endoscope with parallel elements arrangement provided the invaginator's cavity with a pressure-vacuum tap (Fig. 42). The inventors suggest to overcome a twofold delay of the invaginator from the tube by recurrent of pressure and vacuum alteration and withdrawal of the tube before its objective is level with the place of invaginator eversion.

* No harmful after-effects following this and other experiments were registered.

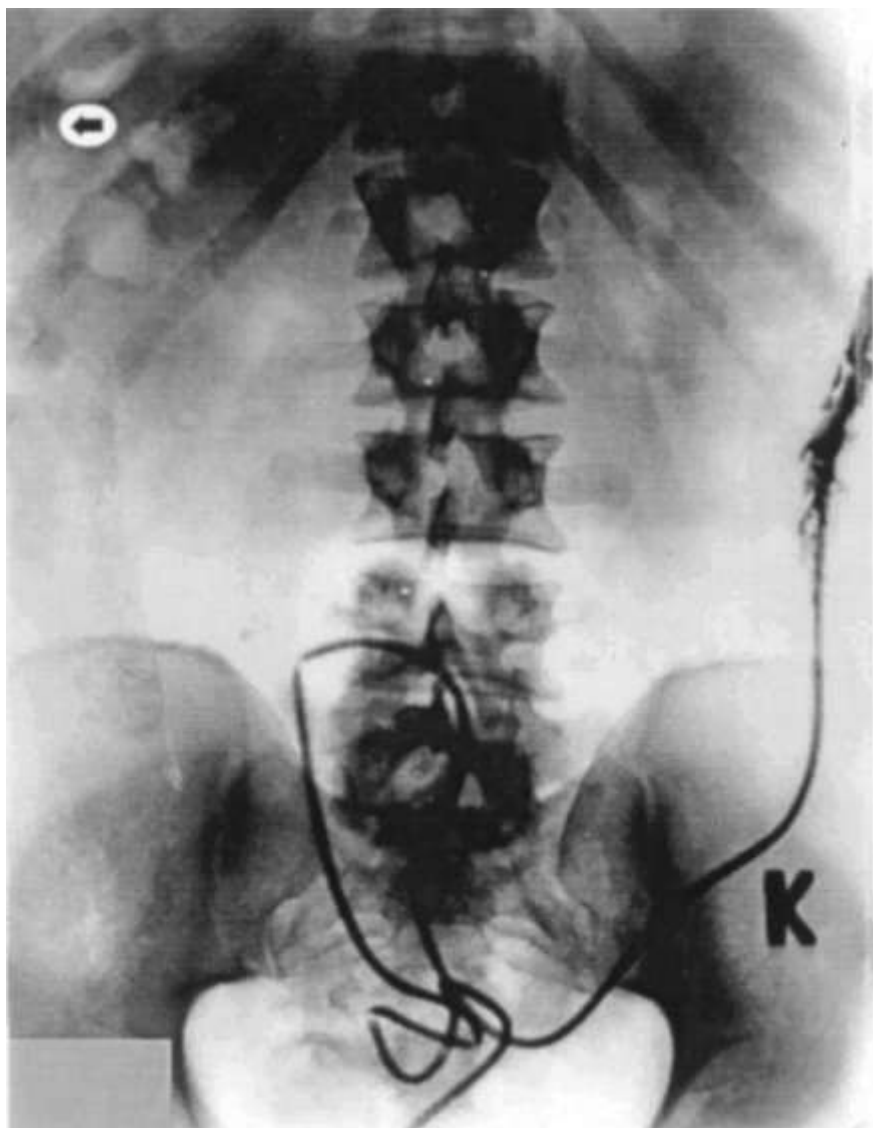


Fig. 41. Testing of the pneumatic method when the invaginator and the tube are in parallel connection (30.06.77., the Second Riga Hospital, S.A..M., 34 y.)

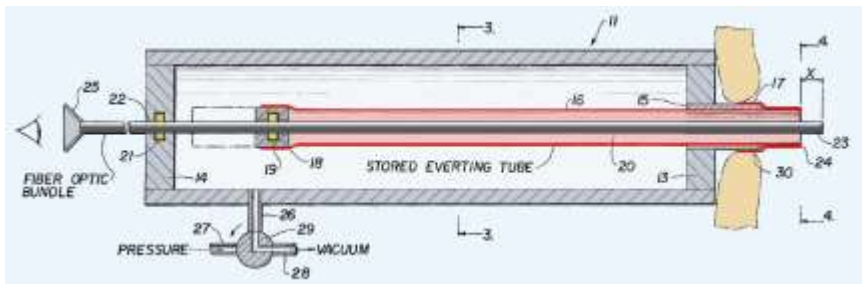


Fig. 42. Rendered graphic sketch of the USA patent № 4.321.915 (Stephen B. Leighton, William H. Boyd, 1982)

This type of intestinal intubation does not provide the desired result: at alteration of pressure with vacuum the inner part of the invaginator will really move away from the tube but will «stick» to the outer part because the invaginator is a thin-walled sheath, its stuck parts will not take the shape of a cylinder, as is shown, but a flat one that will lead to the tube removal together with the invaginator.

In 1978 I made an application for the «Intestinal Endoscope»* the pneumo-manual transport system of which was free from the aforementioned demerits.

To provide the side pressure limit of the invaginator on the intestine the maximum diameter of the former must not considerably exceed the maximum diameter of the latter. The diameter of anastomosis between the small and large intestines in adults is about 13 - 14 mm; taking into account some extension of sphincter tissues a new universal invaginator** was manufactured providing that its diameter should be less than 16 mm under maximum working pressure and body temperature.

* invention for "Strictly confidential use"

** this invaginator is meant for combined examination of the large and small intestines; it was also used in the "Intestinal Intubator with the Drain"

Completion of the work with the «Colonoscope for Family Doctors» is being delayed for more than 12 years due to lack of a suitable endoscope tube. Attempts to use a stiff manual endoscope revealed its full incompatibility with the invaginator. Figuratively, «a horse was harnessed with a timid doe».

A strong resistance to bending of manual endoscopes has been achieved by their complex structure. Design and manufacturing of an endoscopic tube for a new device will be considerably simplified.

Because of an exclusive state control in our country over everything I was forced to imitate an endoscopic tube. The tube imitation had an external diameter of 5 mm, its maximum resilience and flexibility limits were about 0.3 kgf and 20 mm; the tube had a channel for feeding air and fluid into the bowel.

Thus, by a forced matching of an uncontrollable, «blind» imitator of an endoscopic tube with «Family colonoscope's» invaginator I have obtained the first pneumo-manual large intestinal probe.

Low results of the first probe test on a volunteer is explained by caution quite natural in such cases: intubation was stopped after resistance to tube insertion was felt and pains in the abdomen developed (Fig. 43). Moderate pains during the following trials did not prevent from obtaining the desired results (Fig. 44 a, b, c)

** this invaginator is meant for combined examination of the large and small intestines; it was also used in the «Intestinal Intubator with the Drain»*

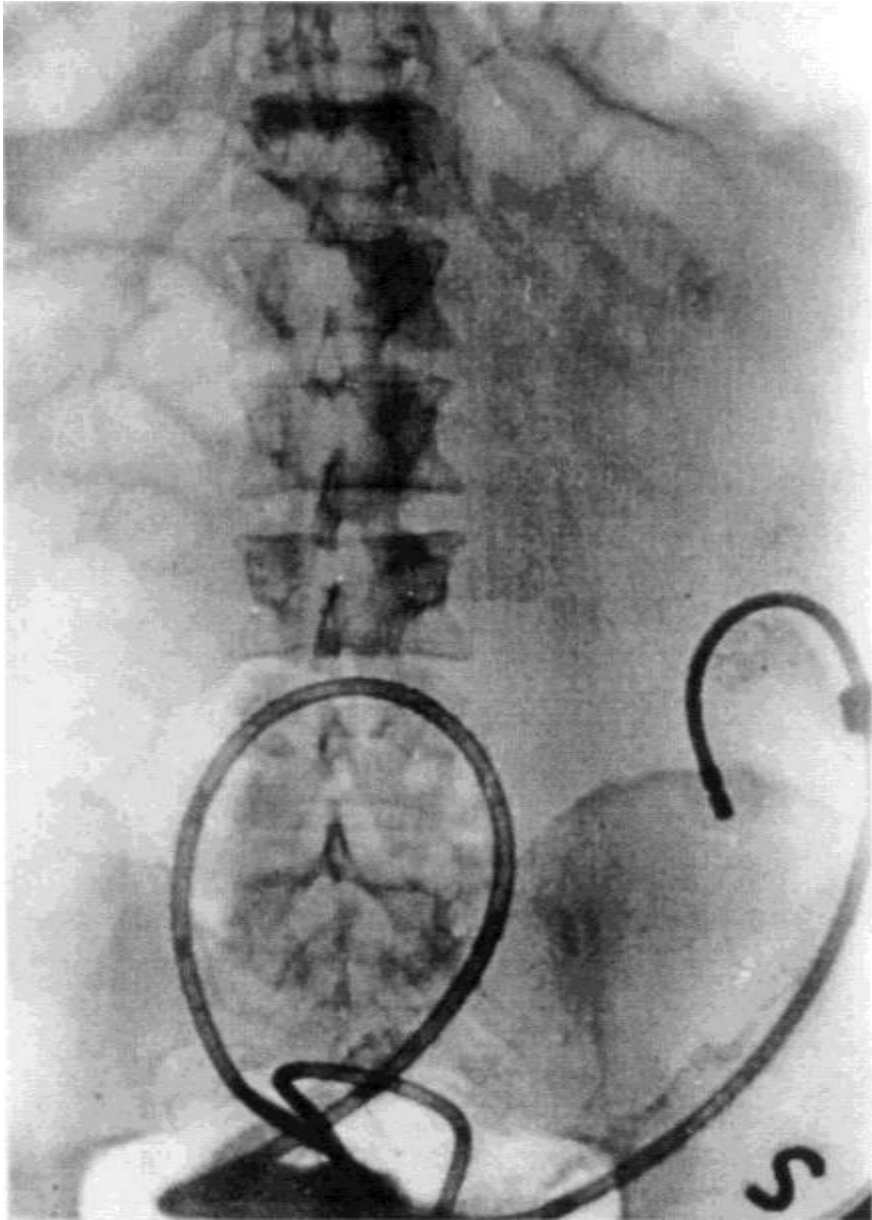


Fig. 43. The first testing of the transport system of the "Intestinal Endoscope"
(20.02.84, the First Riga Hospital, M.S.A. 40 y.)

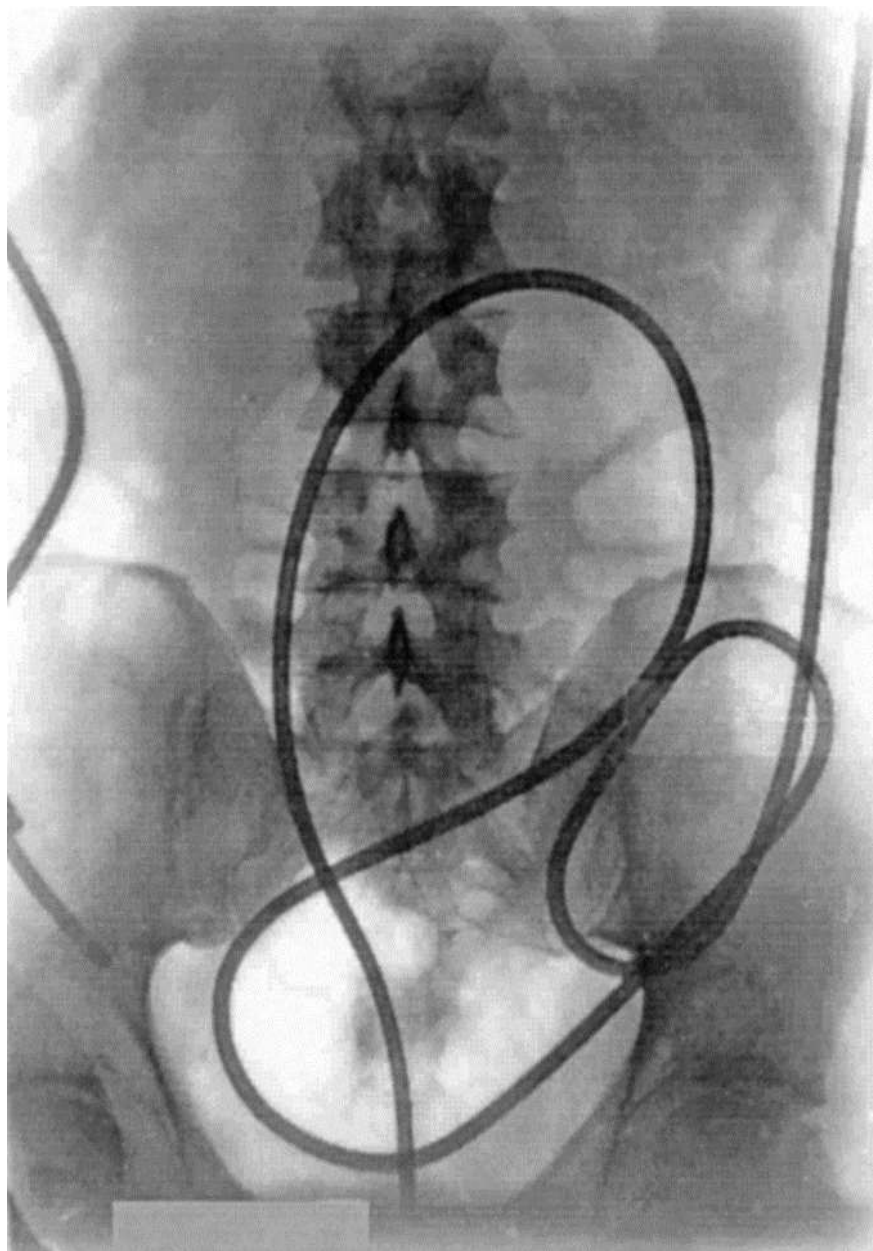


Fig. 44a. Maximum result of the transport system trial of the "Intestinal Endoscope" (03.06.85., the First Riga Hospital, M.S.A., 41 y.)

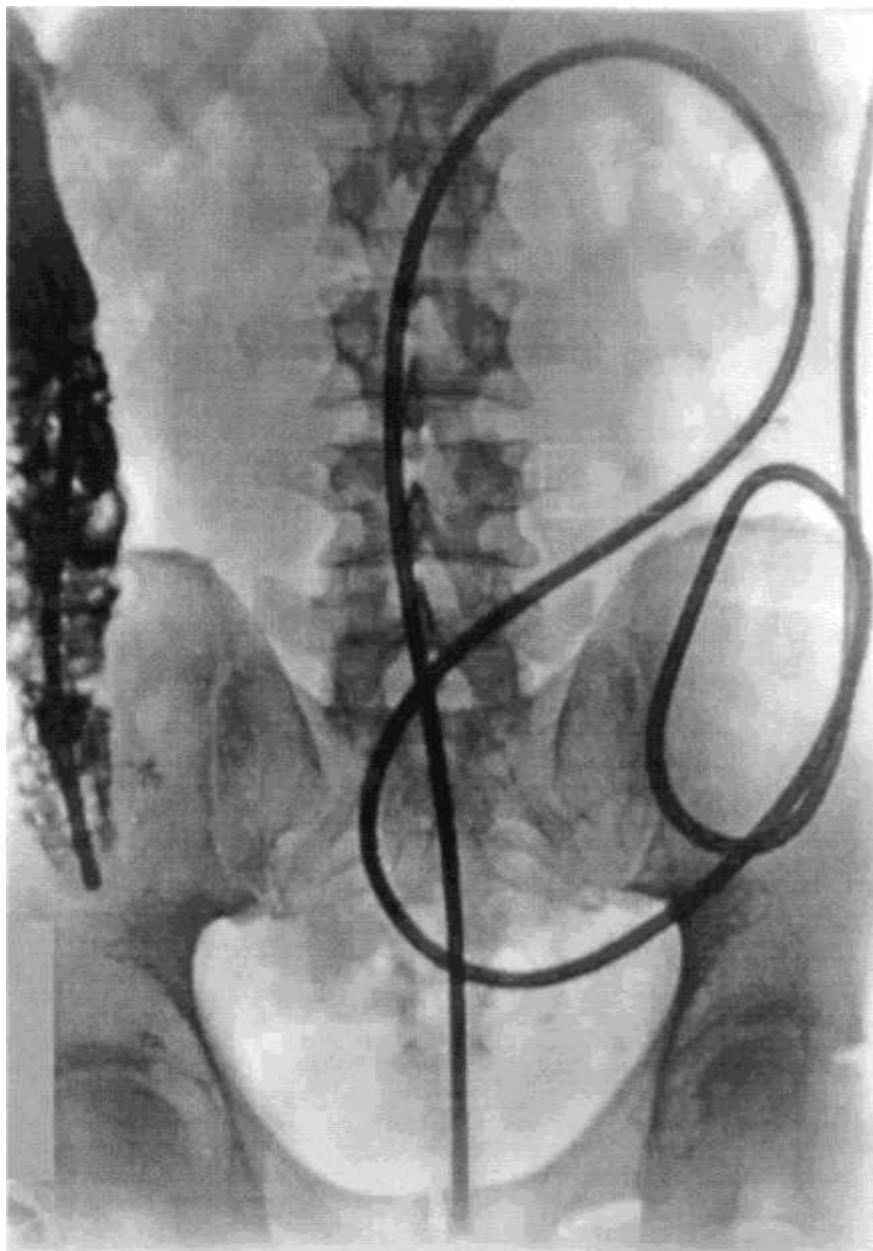


Fig. 44b. Maximum result of the transport system trial of the "Intestinal Endoscope" (03.06.85., the First Riga Hospital, M.S.A., 41 y.)

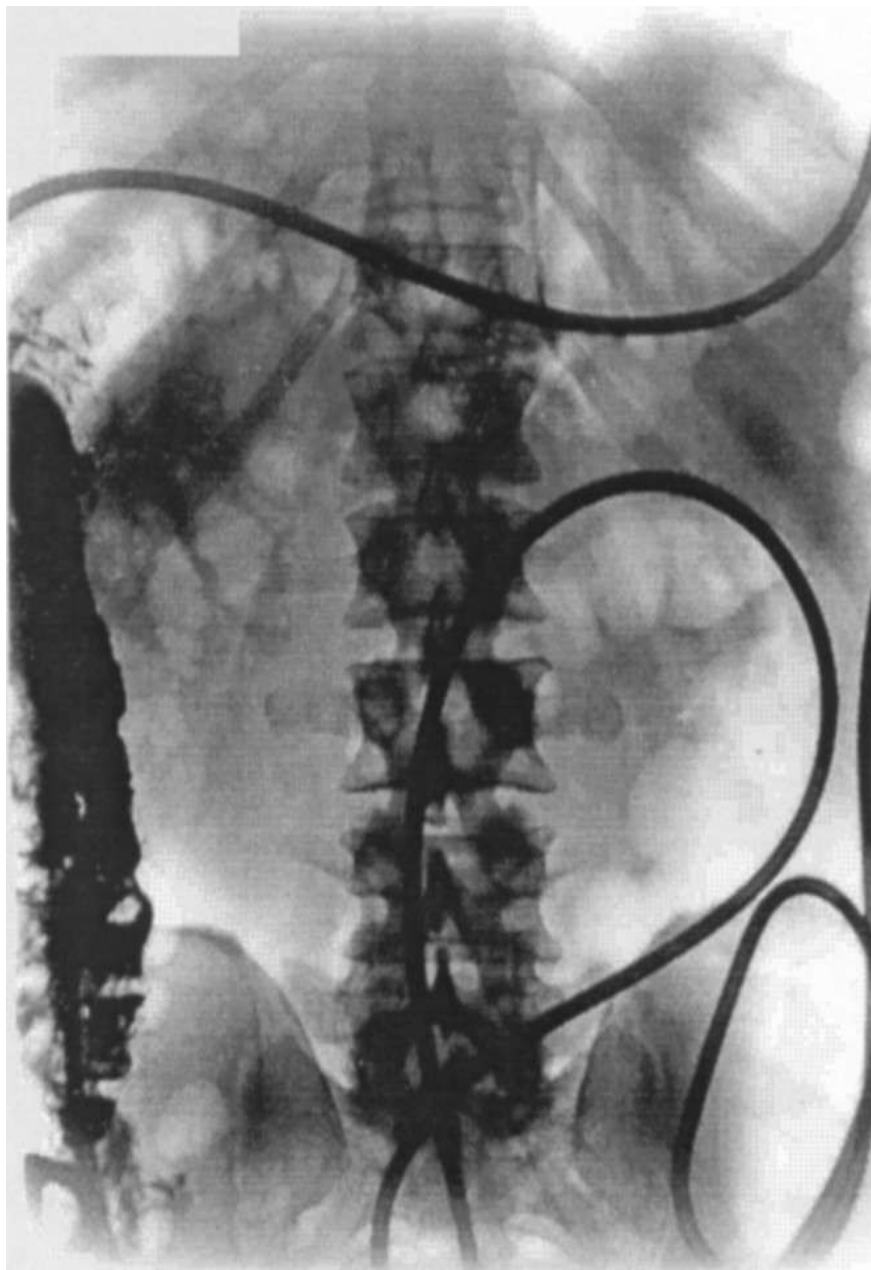


Fig. 44c. Maximum result of the transport system trial of the "Intestinal Endoscope" 03.06.85., the First Riga Hospital, M.S.A., 41 y.)

Moderate pains accompanying those two intubations I explained by exceeding the pressure limit of a ball-tip of the probe on the bowel during its introduction into the acute-angled flexures of the colon. A rope mechanism of guiding the distal end in my colonoscope will not function because the tube follows natural flexures of the intestine. The second probe with another adaptation mechanism of the tube's distal end to the axis of the intestine showed completely new possibilities of intubation: a roentgenogram in Fig. 45 shows a turn of the tube in the region of the Kennon-Bem sphincter, repeated antegrade intubation of the transverse colon and the splenic flexure; a roentgenogram in Fig.46 reveals retrograde intubation of the left part of the colon, a turn somewhere at the region of the splenic angle, repeated antegrade intubation of the left part of the colon.

On testing the second probe spasmolytics were not administered, but painful and on the whole subjective sensations during intubation were absent even at the time of 180⁰ turn of the probe and during its movement in the opposite direction.

Positive subjective and earlier conducted objective* assessment of injury induced by this new method permits us to note that the basic demand for the «Colonoscope for Family Doctors» - a safe introduction of the endoscopic tube has been met.

The second demand to the new colonoscope - availability of intubation has been also complied with: it can be proved by the fact that tests of the probe have been conducted by people who are far from medicine (engineers A.A.Motasov, J.M.Apsit) and who were trained in less the half an hour.

* *Layer-by-layer extent of trauma of the intestine see on pages 111, 114*

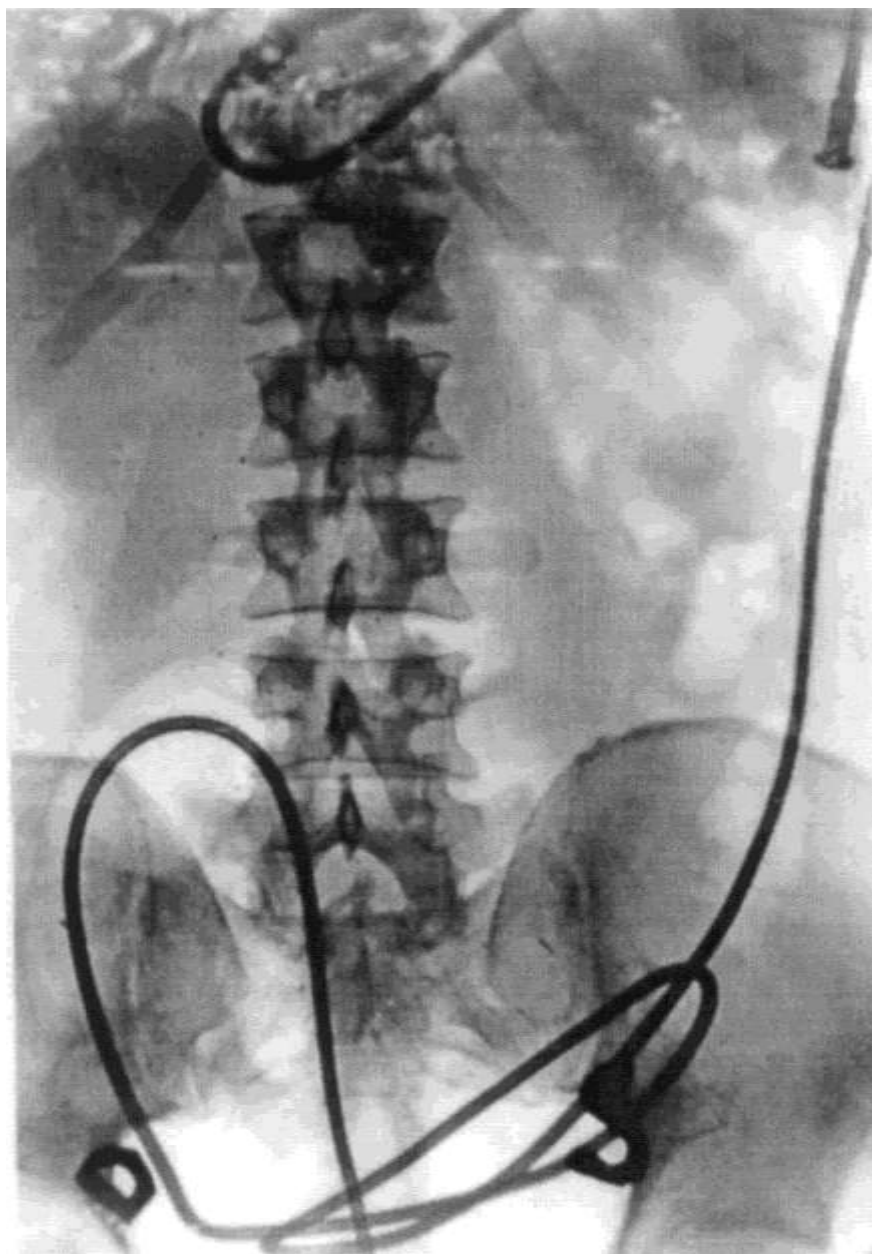


Fig. 45. Testing of the transport system of the "Intestinal Endoscope" (10.02.86., the First Riga Hospital, M.S.A., 42 y.)

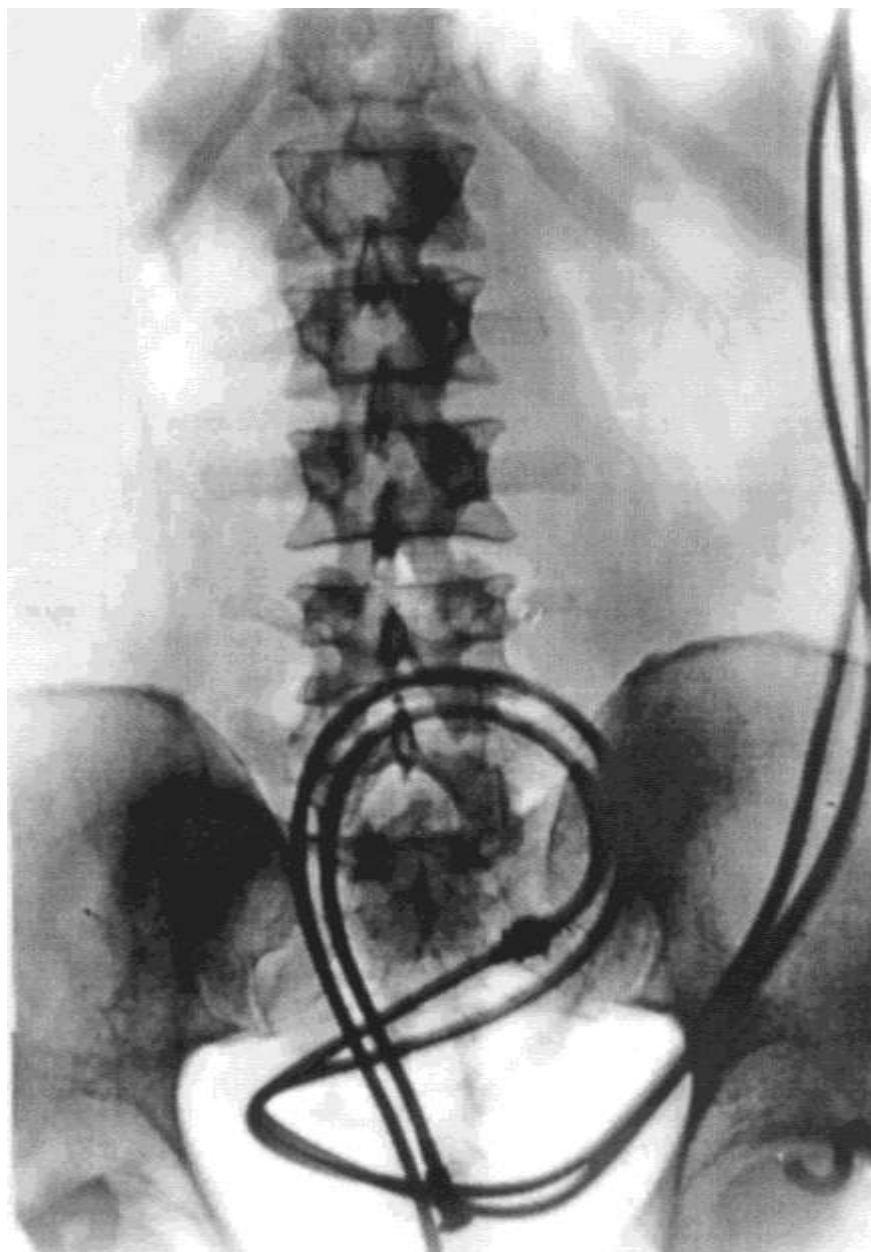


Fig. 46. Testing of the transport system of the "Intestinal Endoscope" (13.02.86., the First Riga Hospital, M.S.A., 42 y.)

Besides, the “Colonoscope for Family Doctors” must be portable and to ensure the quick assembling. The colonoscope’s ocular or endovideocomplex must be replaced by small LCD screen. The coupling of the colonoscope with personal computer will ensure the data transfer by the telemedical nets, for example, from the provincial family doctor to the diognosts of oncologic center.

Taking into account the scale of problem, colon cancer might be controlled if colonoscopy becomes available to wide circles of outpatient doctors and in the first place to family doctors.

Inaccessibility of today’s colonoscopy is connected with the complexity of colon intubation.

The mistakes in the diagnosing of colon cancer and of precancerous diseases are inadmissible. Screening of the risk groups needs the creation of the system, wherein the family doctor, using new colonoscope, performs the colon mucous image record and than, with the help of telemedicine, transfers the image in the oncological center for interpretation.

The potential accumulated during the work permits immediate realization not only of a new colonoscope but of a transanal intestinoscope as well. Optimism based on this potential allows me to finish the chapter with the words «*to be continued*».

THE FIRST INTESTINAL INTUBATOR WITH DRAIN

Thanks to a long «stand selection» and experiments on dogs the device (Fig. 48) has been made which secures pneumo-manual intubation, lavage of the intestinal cavity, mechanical stimulation of intestinal peristalsis and motility of intestinal loops in the abdominal cavity.



Fig. 48. Layout of the first "Intestinal Intubator with Drain"

3.6.1. INVESTIGATION OF THE TRANSPORT FUNCTION OF THE DEVICE

An intubator is meant for transanal, intraoperational introduction of an invaginator and drain-irrigation elements into the intestine. Transanal intubation is the safest and most acceptable technique because of a number of objective reasons. The transoral variant besides the aforementioned demerits threatens with transfer of the large bowel content into the proximal portions of the tract during extubation.

The parallel type of connection of the invaginator to the tube is used in the device (Fig. 40); unlike the consecutive type (Fig. 39) it allows evacuation of the intestine during intubation but after its completion secures a contact of the whole drain-tube with the intestine.

Intestinal intubation before an operation is dangerous because emptying of the intestine without revision of the abdominal cavity can obscure the picture of ileus or peritonitis. Clinical experience also speaks in favour of intraoperational intestinal intubation: a surgeon is never sure in the postoperative period, the postoperative complications in the majority of cases are on the part of the intestine. Intubation in the postoperative period, I think, is expedient only in case of open (half-open) treatment for peritonitis.

Intraoperational intubation allows visual and palpatory control over intestinal insertion. Proceeding from this, provision of the advance-guard pressure limit of the invaginator on the intestine, was entrusted with a surgeon; the side pressure limit on the intestinal wall is to be secured with the invaginator up to 16 mm in diameter.

One of the demands of the conception of the prospect - synergy of intubation forces. The transport function of the first device was

performed by «a duet» with the participation of pneumatic and manual forces (Fig. 49).

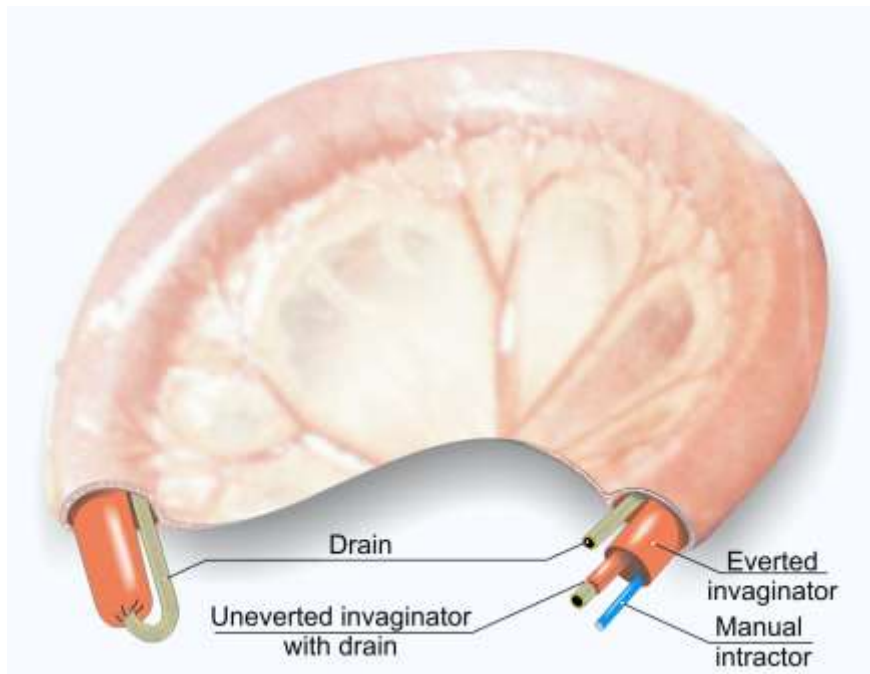


Fig.49. Due to the pneumo-everting invaginator and manually introduced intractor, the invaginator rolls on, but the drain unloads on the intestinal mucosa

The manual intractor *, drawing in the inner part of the invaginator into its everted and dilated outer part, resembles a 4.5 m long tightly coiled spring enclosed into a fluoroplastic tube with the external diameter of 2.6 mm, the inner end of which is supplied with a detachable lock of the invaginator's inner part.

For a theoretical analysis of pneumo-manual intubation variants. I used the sum $2a+b+c=d$, where a - stands for the length of the inner part of the invaginator situated more distally than the intractor lock, b - the depth of intractor introduction, c - the length of the inner part of the invaginator next to the lock, d - total length of the invaginator.

* from Latin "in" - in, "traho" – drag, pull

The first critical moment of intubation appears at the maximum value of the inner part of the invaginator: for example, for intubation of the intestine at the depth of 5 m and the inner part of the invaginator being 2.5 m long (Fig. 50 above). According to anatomy about 1.2 m out of 2.5 m will be placed in the colon and 1.3 m in the ileum.

The second critical moment I single out in the beginning of the final, exclusively pneumatic intubation stage. For determination on the inner part of the invaginator at this moment, a difference between the total length of the invaginator and the depth of intractor introduction must be divided into 2. An invaginator being 5 m long and when the intractor is inserted at the level of 2.5 m, the searched - for value amounts to 1.25 m (Fig. 50 below). These 1.25 m correspond to the mid-third of the small bowel. Thus, the depth of intubation at any time of the pneumo-manual stage equals to $a + b$, at the first critical point - $d:2$, at the second one - $d - a$. only the intractor can actually indicate the depth of the pneumo-manual intubation: it amounts to $\frac{1}{2}$ of all its translational motions. The position of the intractor itself amounts to the difference between its translational and reciprocating motions.

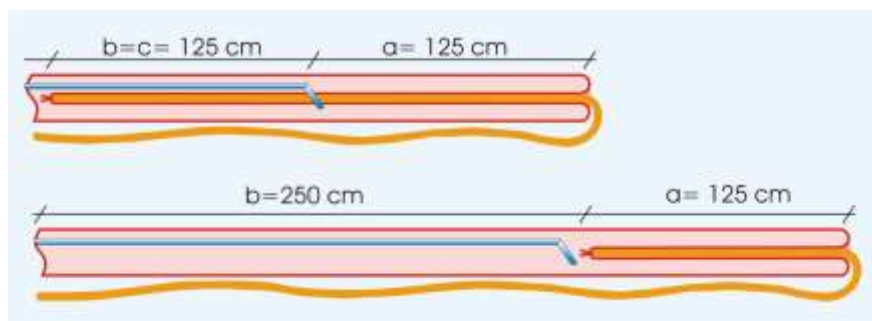


Fig. 50. A scheme represent he first critical moment in the functioning of the transport system of the device (above) and the second one (below)

Synergy of pneumatic and manual intubation forces can be secured only by a rational program of work with the intractor. On drawing up the program the transanal introduction limit of the intractor and the limit of exclusively pneumatic small intestine intubation must be considered.

On studying the mechanism of pneumatic intubation it was found that the inner part of the invaginator occupying the shortest distance between forces and , i. e. lying close to the lesser radius of the outer part (Fig. 24), because of its area and flexibility takes the shape of a sail (Fig. 51 left). As a result, a close connection between the inner and outer parts of the invaginator which is already present and has a negative effect on intubation becomes stronger due to their «sticking» under the action of air pressure.

Due to the right profiling of the invaginator (Fig. 51 right) exclusively pneumatic intubation of the small intestinal part of an intestinal model amounted to 2.5 - 2.8 m.

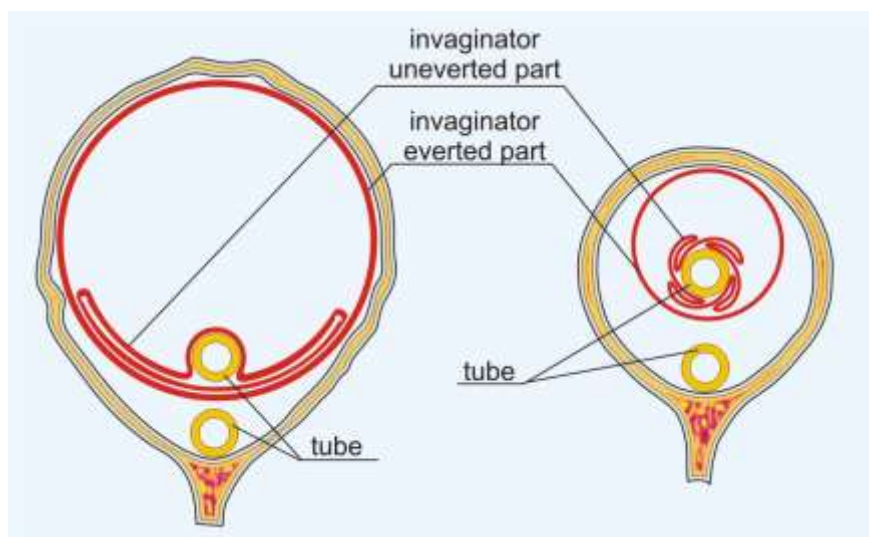


Fig. 51. Section of the bowel with a conventional invaginator (left) manufactured by A.A. Zjabbarov. The bowel with the profiled invaginator and the drain (right)

Potentialities of the pneumo-manual method of transportation, layer-by-layer extent of intestinal trauma induced by intubation were tested on sound dogs under similar conditions as during the revision of the palpatory method.

The basic moments of the intubator assembly are shown on Fig. 52 - 56.

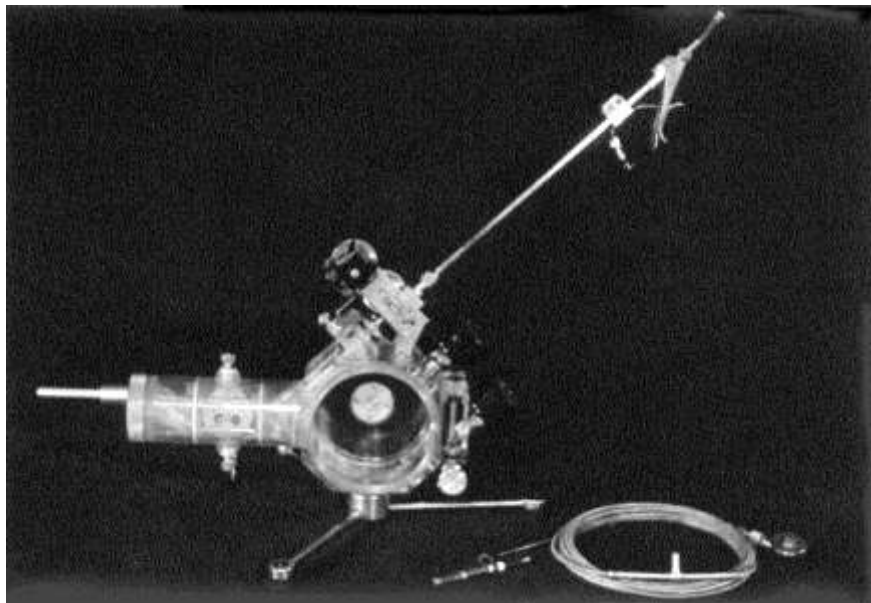


Fig. 52. The chamber and the intractor before assembly

In the operating room a surgeon's assistant attending the apparatus removed the foot part of an operating table, fixed the device to the table (Fig. 57) and proceeded to introduction of a rectal tube. To traverse the sacral flexure of the rectum the tube is curved; its length allows insertion of the invaginator right into the sigmoid colon without touching the voluminous ampoule within which the invaginator can start moving in the opposite direction. The tube connection with the chamber's branch pipe is secured by means of a clamp of V. L. Sysojev, that preliminary fixes the invaginator on the branch pipe.

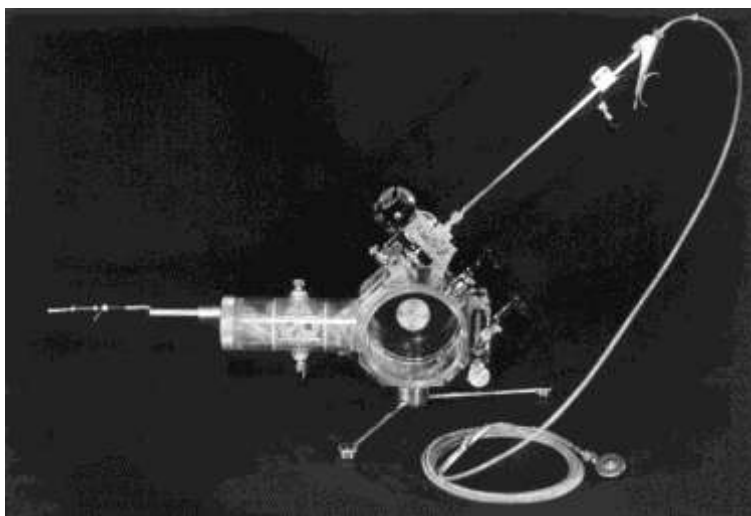


Fig. 53. The intubator assembly: the intractor is passed through the chamber and attached to the pneumo-lock

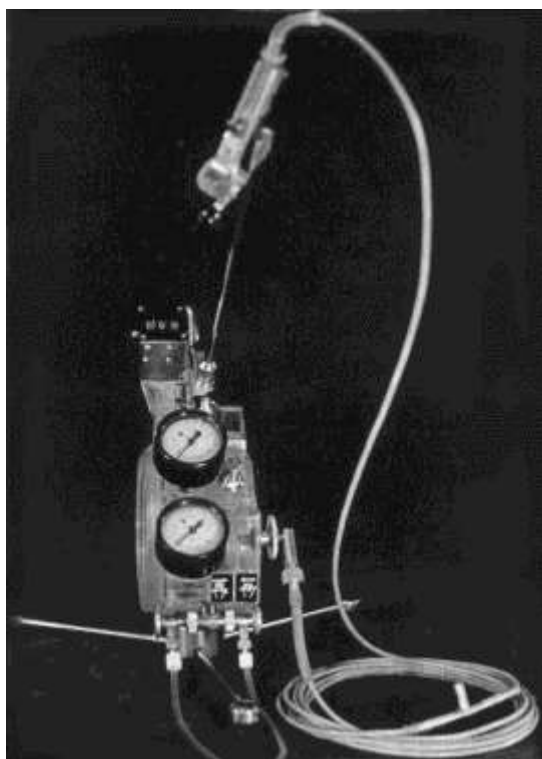


Fig. 54. The intubator assembly: the intractor is connected with the pressure-vacuum tap

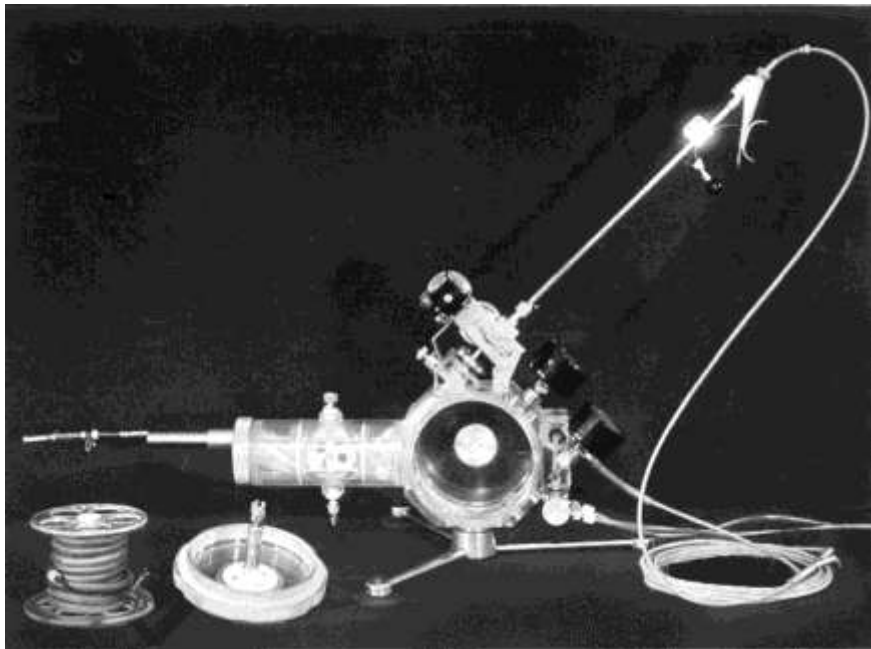


Fig. 55. The intubator assembly: a reel with the invaginator and drain-irrigation elements is prepared to be placed into the chamber

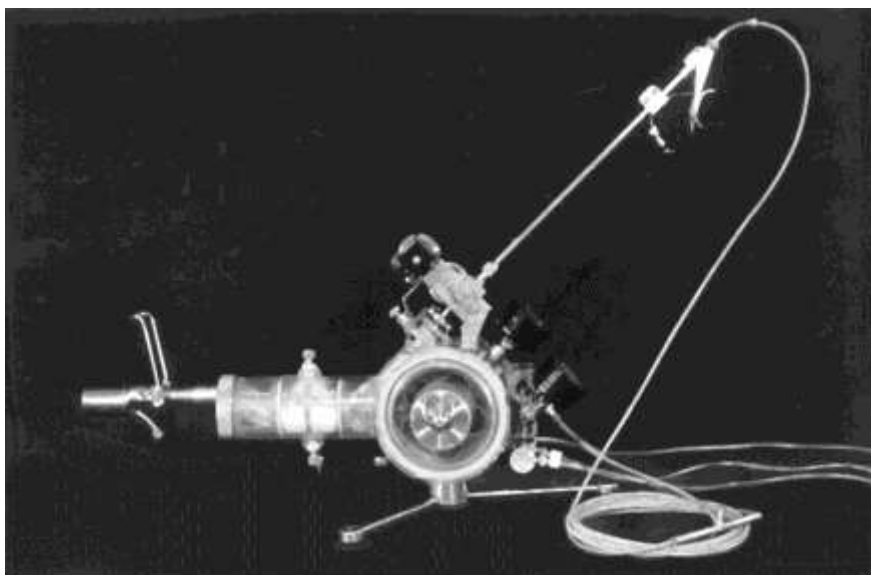


Fig. 56. The intubator assembly: a reel is within the chamber, the invaginator is everted on the branch pipe and prepared to be fixed by Sysojev clamp

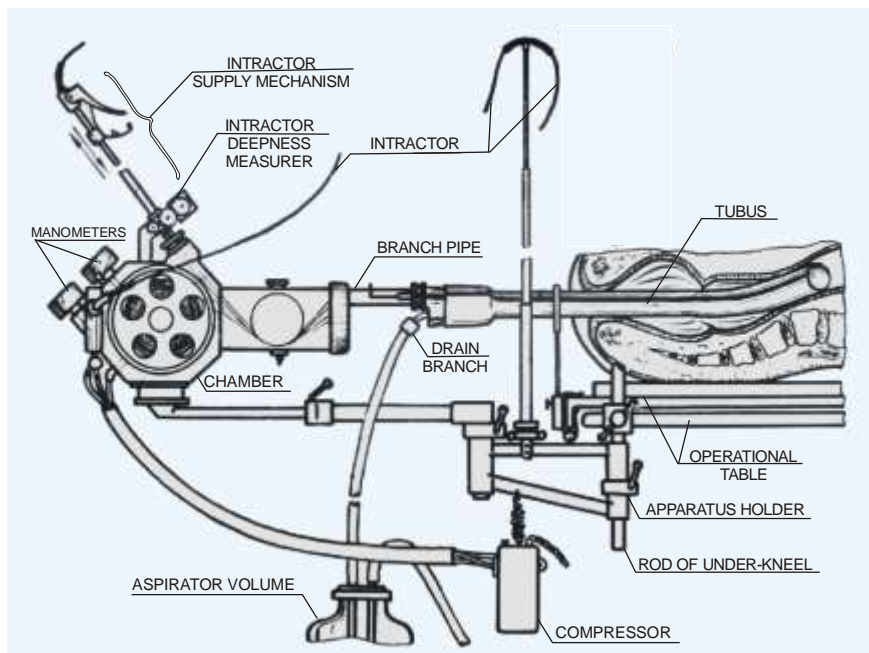


Fig.57. A sketch of the device ready for intubation

The surgeon having measured the length of the intestine, the assistant stepped into position at the foot part of the operating table, switched on pumps and started intestinal intubation. Both controlled the process: the surgeon - by insertion of the invaginator into the intestinal loops and the assistant - by rotation of the reel seen through a transparent wall of the chamber. Movement of the intractor within the outer part of the invaginator was controlled by the assistant with the aid of a depth indicator. In the proximal part of the colon the surgeon obstructed the entrance to the cecum with fingers and directed the invaginator to the ileocecal valve. On intubation of the small intestine the correction of invaginator insertion was actually not needed*.

* Some experiments are cinema and video recorded.

During intubation narrowing of the bowel was often present just right before the invaginator which was driving is back in the oral direction This reaction of the intestine to a distended invaginator slowed down its eversion. The appearance of the intestine, when the invaginator was under pressure, was identical to one revealed at laparotomy for ileus (Fig. 58), however the intestine had a rosy coloring, the serosa glittered, its lesions were absent. When the invaginator was without pressure, the natural configuration of the evacuated intestine was changed by the stiff intractor (Fig. 59); other intraintestinal elements at this and also after intractor removal did not visually differ.



Fig. 58. The intestine with the invaginator under pressure

Motor reaction of the intestine to its volume alterations drew my special attention: air having been removed from the invaginator, the intestine contracted in a pendulum-like manner, was spasmodic. All these observations suggested the idea to apply *the invaginator* in the post-operative period as *mechanical stimulator of peristalsis and a fluctuator* of the intestine*.

* from Latin "*fluktuatio*" - wave-like movement.

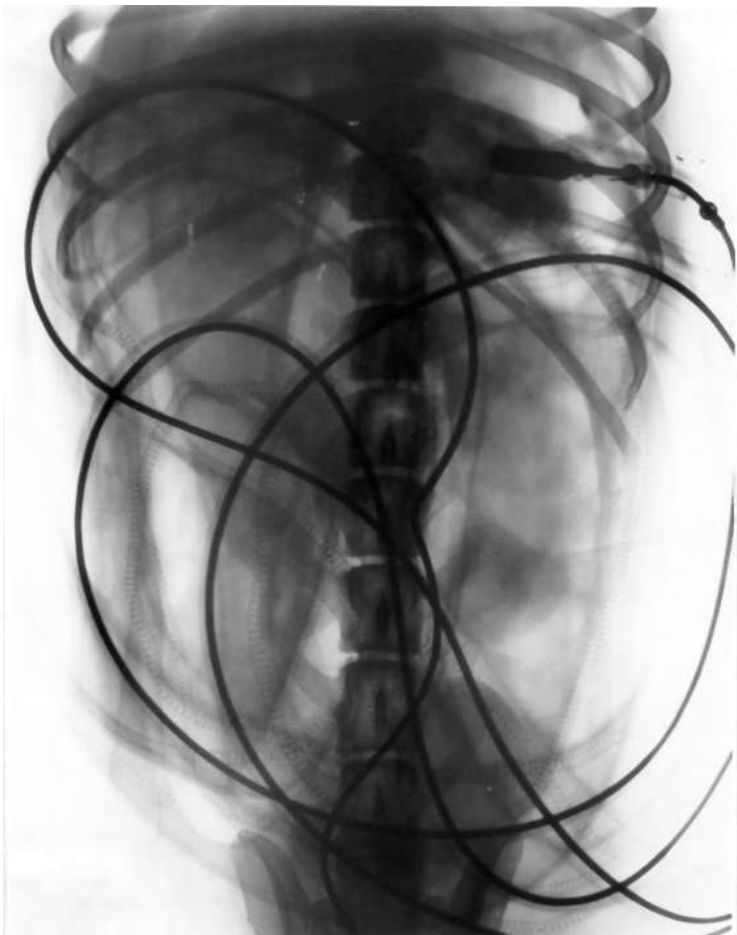


Fig.59. A roentgenogram of the canine open abdominal cavity: configuration of the Intestine is determined by the stiff invaginator

To documentation the fluctuation effect of intestinal loops they were placed into the abdominal cavity and it was closed with some via all layers sutures. The first roentgenogram was made with air pressure within the invaginator, the second one – without it (Fig. 60, 61). The position of the intestine in the abdominal cavity was assessed by the configuration of a metal spiral of «The Intestinal Drain» enclosed in the abdominal cavity together with the invaginator.

Assessment of the transport system of the «Intestinal Intubator with Drain» is made in table 5 in the same form as in table 3.

Results of pneumo-manual intestinal intubation.

Table 5.

№	Dog's name	Length of the intestine	Intubation depth	Intubation time	Layer-by-layer extent of trauma induced by intubation				
					m (m)	s.m (m)	mc (m)	ml (m)	ser (m)
1.	Big	4.1	4.3	25	0	0	0	0	0
2.	Lilac	4.5	4.2	25	0	0	0	0	0
3.	Jack	4.4	4.1	20	0	0	0	0	0
4.	Sad	4.1	3.8	28	0	0	0	0	0
5.	Bobic 2	4.0	3.8	25	0	0	0	0	0
6.	Black	3.6	4.0	23	0	0	0	0	0
7.	Grey	4.4	4.2	20	0	0	0	0	0
8.	Zhuchka	4.0	4.0	14	0	0	0	0	0
9.	Willow	4.3	4.0	13	0	0	0	0	0
10	Quiet	4.4	4.2	25	0	0	0	0	0
	M±m	4.2±0.3	4.1±0.2	21.3±5.7					

(Abbreviations: m - mucous; s. m. - submucous; mc - muscular circular; ml - muscular longitudinal; ser. - serous.)

Difference in the length of the intestine from 3.6 to 4.5 m is due to ineffective attempts to determine this value before the operation. Comparing the length of the animal intestine with the length of elements introduced into it, it is clear that these values were equal in experiment No 8, in experiments No 1 and 6 the second value was greater than the first one *; the other seven experiments allowed to compare morphology of intubated and non-intubated portions of the intestine.

* In experiments No 8, 1 and 6 we, figuratively, «passed the stop».



Fig. 60. A roentgenogram of the canine abdominal cavity: configuration of the intestine under working pressure in the invaginator



Fig. 61. A roentgenogram of the canine abdominal cavity: configuration of the intestine without pressure in the invaginator

Intubation time varied from 28 to 13 min. Duration of the procedure depends on the assistant who realizes the manual force; about 10 min were spent on advancement of the invaginator from the large into small intestine that requires coordinated actions of both the surgeon and his assistant.

Segments from the intestine for histological studies were removed in the same way as for the assessment of palpatory trauma. Microscopic examination of histological specimens of the colon did not reveal any traumatic lesion of its structures. Small oedema and plethora of vessels in all layers of the intestinal wall were present actually in all portions of the small intestine. Some vascular ectases at the base of villi, lymphostases in the submucosa and at the border between muscular layers were observed. Small oedema and plethora of vessels were noted in the non-intubated portion of the duodenum as well.

Experiments conducted on dogs proved the following: pneumo-manual intestinal intubation unlike the palpatory one is shorter (25.8 ± 5.7 and 21.3 ± 5.7 mm) and more efficient (the length of introduced elements is correspondingly 2.4 ± 0.4 and 4.1 ± 0.2 m); rolling on of the invaginator and drain-irrigation elements, unlike «drawing» of the tube by the palpatory method, does not induce injury to intestinal tissues.

Experiments also showed that the invaginator can be used in the post-operative period as an intestinal stimulator-fluctuator. Comparison of the invaginator with the tube-drain used in the palpatory method shows that the tube that fixes intestinal loops secures prevention of ileus but not of intestinal commisures; on the other hand, the invaginator ensures prevention of commissaries with a dynamic means consisting of motility of intestinal lops in the abdominal cavity. The basic demerit of pneumo-manual intubation is its actually full dependence on a surgeon's assistant: a surgeon is passive in this process.

3.6.2. ARGUMENTATION OF THE EVACUATION FUNCTION OF THE DEVICE.

Due to necessity of following the pressure limit on the intestine, a drain has been selected as a result of stand tests which resembles a spiral spring enclosed into an elastic stockinet sheath (Fig. 62). The outer diameter of the spiral made of corrosion resistant spring wire with the diameter of 0.2 mm, equals to 3 mm, with a pitch of a bit more than 1 mm. The sheath manufactured with a round knitting machine from elastic silk threads has a structure of knitted stitch. The size of the drain's stocking side holes can vary from 0.1 to 0.3 mm. Even knotted the drain retains its channel: coils of the spiral and loops of stockinet become extended at the place of the greater radius of the curve and are drawn closer at a lesser one. The maximum drain flexibility amounts to its outer diameter (4 mm) but the maximum resilience does not exceed the pressure limit on the colon.

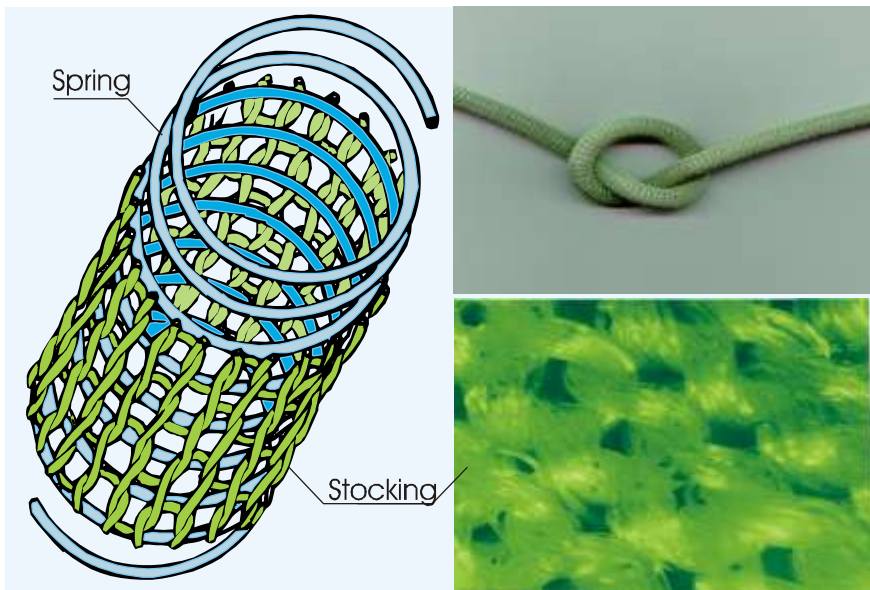


Fig. 62. The construction of new drain keeps the canal at any flexures and allows the filtration of intestinal contents

Safe functioning of drain also depends on the value of working vacuum within it. The atraumatic transport system permitted the study of vacuum action on the intestine after completion of intubation. Vacuum in the canine intestine was produced for 10 min., its height in the first experiment corresponded to the maximum noted in literature; in the following experiments vacuum was progressively lowered (table 6). The intestine, having been under vacuum for 10 min, was incised in a longitudinal direction and portions of it were removed according to the conventional scheme for histological examination of injury induced by vacuum.

Search results of a safe intrainestinal vacuum.

Table 6.

№	Dog's name	length of the intestine	Intubation depth	Intubation time	Vacuum within the drain	Layer-by-layer extent of trauma induced by intubation				
		(m)	(m)	(min)	(kgf/cm ²)	m (m)	s.m (m)	mc (m)	ml (m)	ser (m)
1.	Motley	3.6	4.0	15	0.8	3.6	3.6	3.6	3.6	0
2.	Myrtle	3.4	4.0	16	0.4	3.4	3.4	3.4	3.4	0
3.	Downy	3.7	4.0	20	0.3	3.7	3.7	3.7	0	0
4.	Badger	3.7	4.0	13	0.25	3.7	3.7	0	0	0
5.	Palm	4.7	4.0	15	0.2	4.0	0	0	0	0
6.	Adroit	4.2	4.5	14	0.2	4.2	0	0	0	0
7.	Chestnut	3.9	4.2	14	0.15	3.9	0	0	0	0
8.	Top	5.0	4.2	12	0.1	0	0	0	0	0

(Abbreviations: m - mucous; s. m. - submucous; mc - muscular circular; ml - muscular longitudinal; ser. - serous.)

As follows from the table the depth of transanal intubation in 6 out of 8 dogs prevailed over the length of the intestine: the ends of the invaginators and the drain were in the stomach. Shortening of the pneumo-manual intubation time as compared with the previous experiments (table 5) is explained by acquisition of some experience by my assistant. Narrowing before the invaginators and in general active motor intestinal reaction to the increase of its volume were observed, in this series of experiments, too.

Observation of the intestine following the attachment of the outer end of the drain to vacuum revealed its spreading in the oral direction; visually vacuum was determined by a seen drain contour. The content entering an electrosuction pump container under vacuum of 0.8 kgf/cm^2 revealed admixture of blood, in other experiments drops were brownish and yellowish in color. Under vacuum of 0.8 kgf/cm^2 the intestine acquired cyanotic coloring, in the other four experiments venous stasis was less marked.

At dissection of the intestine the mucosa of the small intestine in the first four dogs revealed a trace of drain sticking to it which looked like a longitudinal dark stripe 3-5 mm wide. Under vacuum of 0.8 kgf/cm^2 the drain was rosy in color. In 4 final experiments the mucosa was normal in color, granulous, velvety, rather dry without visually observed changes.

Microscopy of the colon treated with vacuum of 0.8 kgf/cm^2 showed presence of marked oedema and plethora of all its layers. The small intestine, that unlike the large one was in direct contact with the drain, against the background of oedema of the mucosa and submucosa, plethora of all the layers, showed pronounced lesions of villi, focal hemorrhages in the mucosa, massive diffuse hemorrhagic saturation of the interstice of the mucosa, focal hemorrhages in the muscular and submucous layers. Similar but progressively decreasing changes were found in intestinal specimens treated with half lower vacuum, as well as with vacuum of 0.3 and 0.25 kgf/cm^2 .

Slight structural changes were present in the intestine enclosing the drain attached to vacuum of 0.2 and 0.15 kgf/cm^2 . For intestinal specimens containing the drain under vacuum of 0.1 kgf/cm^2 , plethora and oedema of tissues were characteristic and in this respect they did not differ from specimens of the non-intubated portion of the bowel.

Thus, by experiments I was trying to find *the safe vacuum limit within the intestine*. But the pressure limits on the intestine obtained theoretically (figuratively «at the tip of a pen») allow to consider these experiments only as auxiliary ones. According to pressure produced by the intestine itself, the vacuum limit for its different portions must be varied; actually vacuum not higher than 0.12 kgf/cm^2 could be recommended for the small intestine and less than 0.04 kgf/cm^2 for the large one.

According to the formula by Poiseuill

$$Q = \frac{\pi}{8} \frac{\Delta P}{l} \frac{\mathfrak{R}^4}{\mu}$$

the force moving the intestinal content down the drain canal is determined by the value ΔP - the difference of pressure at the inner (P_{in}) and outer (P_{out}) end of the drain.

To illustrate my approach to intestinal evacuation I have divided the process into four basic stages:

- stage I* - gas evacuation;
- stage II* - removal of chyme (viscosity μ_1) from proximal portions of the small intestine;
- stage III* - removal of a thick chyme (viscosity μ_2) from the distal portion of the small intestine;
- stage IV* - emptying of the colon (content viscosity μ_3).

The content of the straight and distal portions of the sigmoid colon can be evacuated in a natural way or by means of enema. The existing intestinal drainage allows to perform the first and second stages.

On the gist of stages.

Stage I. In the beginning of stage I $P_{in} > atm$, as a result $\Delta P > 0$ even at $P_{out} = atm$. In other words, intestinal decompression takes place without connection of the drain's outer end to vacuum. The end of stage I and beginning of stage II can be expressed as $P_{in} = P_{out} = atm$.

Stage II. The fluid intestinal content becomes thicker in the aboral direction and this explains a great number of supporters of transoral intubation. Chyme μ_1 can be removed with and without electroaspiration. It is known that if the outer end of the transoral drain is placed, for example, at 1 m below the patient's bed then $P_{out} = -0.1 \text{ kgf/cm}^2$.

Stage III. Clinical trials of one-channel transoral drains show that $P_{out} = -0.1 \text{ kgf/cm}^2$ does not ensure evacuation of chyme. My stand experiments with a transparent intestine and drain revealed that even considerable increase of vacuum does not secure movement of chyme μ_2 down a one-channel drain: chyme column having reached a certain length interrupts the movement anew.

If air is brought to tube's side holes as it is conceived in two-channel drains, but the outer of orifice a safe vacuum - P_{out} , for example, 0.1 kgf/cm^2 , then ΔP will be higher than 0.1 kgf/cm^2 . However, efficacy of two-channel drains is determined not by the value ΔP but the amount of babbles alternating with chyme μ_2 columns.

Stage IV. In addition evacuation of the whole chyme μ_2 and realization of the stage IV without intestinal irrigation and drain recanalization along its whole length is practically unreliable. Fluid will force drain plugs back into the intestine, decrease density of chyme μ_2, μ_3 , transfer its particles.

The sum up of all the discussion - the conception of the evacuation function of the «Intestinal Intubation with the Drain»: *the pressure limit on the intestine, difference of pressure at the ends of the drain, recanalization of the drain and irrigation of the intestine.*

The intubator with the drain allows to combine the transport and evacuation functions, however, it is expedient to restrict the latter during the operation by implementing stages I and II.

The gist of the post-operative application of the evacuation system of the device lies in alteration of liquid introduction into the drain and its removal, from the intestine. Indefinite amount and quality of chyme in an operated patient does not allow to speak about the amount of washing liquid and time period for complete examination and treatment of the intestine. Similar amount of introduced and removed washing liquid as well as the control of blood electrolytes - are conditions of safe execution of stages III and IV. Intestinal lavage can be stopped after manifestation of full value peristalsis.

3.6.3. ON TESTING THE FIRST DEVICE AND DEMANDS FOR THE NEW ONE

The first clinical trial of the «Intestinal Intubator with the Drain» carried out on 17.02.80 with permission of the authorities of the Military Hospital № 289 was unsuccessful. A hospital death certificate reads: «A patient A. N. K., aged 75 was urgently operated for obturating tumour of the colon. During the immediate post-operative period failure of anastomosis occurred in the patient with the development of peritonitis, death ensued on the 16-th day following the operation».

A reel with the invaginator comprising drain-irrigation elements as a matter of fact is a cassette meant exclusively for a single application. Insufficient number of repeated clinical trials (2) of the device is due to

shortage of means, «home» technology of cassette manufacturing and permanent threat of closing the work.

On a commission from the Health Ministry of the USSR, All-union Research Institute of Medical Technique conducted a technical test of the «Intestinal Intubator with the Drain» and permitted medical trials (act TJ 0.0007.791 on 28.09.82). Testing of the device was entrusted with the department of hospital surgery at the Second Moscow Medical Institute. Two patients with tumour of the colon were chosen for intubation. It was carried out immediately after tumour resection and formation of anastomosis. Intubation of the colon and a portion of the ileum was considered to be sufficient for the first patient (275 cm); the second patient was intubated at the level of 75 cm (Fig. 65). The conclusion of the department on (23.02.83) about testing the «Intestinal Intubator with the Drain» reads: «The method presented gave good clinical effect and can be recommended for the treatment of patients suffering from ileus, peritonitis, for protection of anastomosis at operations for colon tumors».

A probability of uncoordinated manipulations of a surgeon and his assistant on passage of the colon, revealed at experiments and clinical trials, has stimulated development of a new device that will ensure a direct control over intubation by a surgeon.

The first device assigned to a surgeon a part of an observer and oral corrector of intubation who was able on his own neither to stop nor resume it. Actually, the surgeon was his assistant's assistant.

Today I am working over the new «Intestinal Intubator with the Drain» (Fig. 66) that will ensure foot control over invaginator introduction and intestinal content evacuation. The time of a new intubation will be less than 3 - 5 min.

An operation and intubation having been over, the outer ends of the invaginator and drain-irrigation elements were transferred through the anal funnel and hermetically attached to corresponding receptacles.

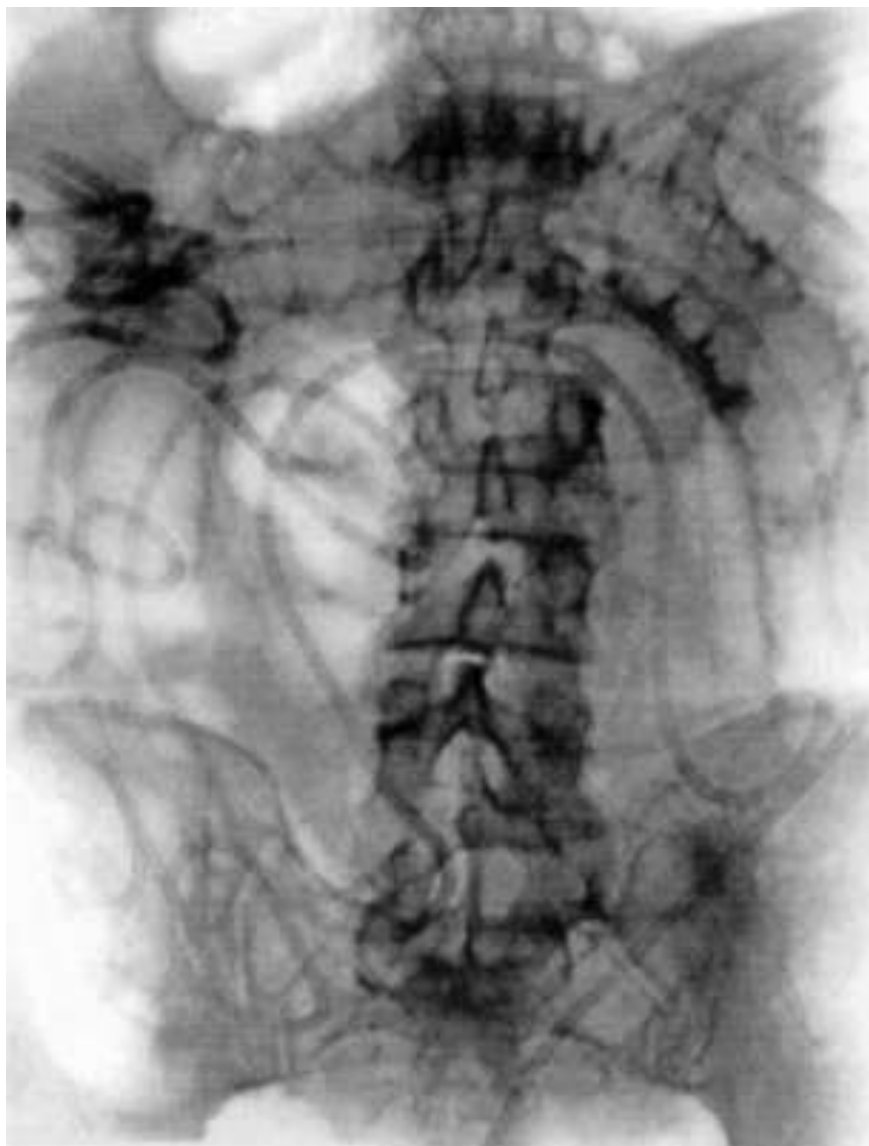


Fig. 65. The clinical trial of the pneumo-manual "Intestinal Intubator with the Drain" (23.02.83., Moscow Hospital № 31, K.A.N., 73 y.)

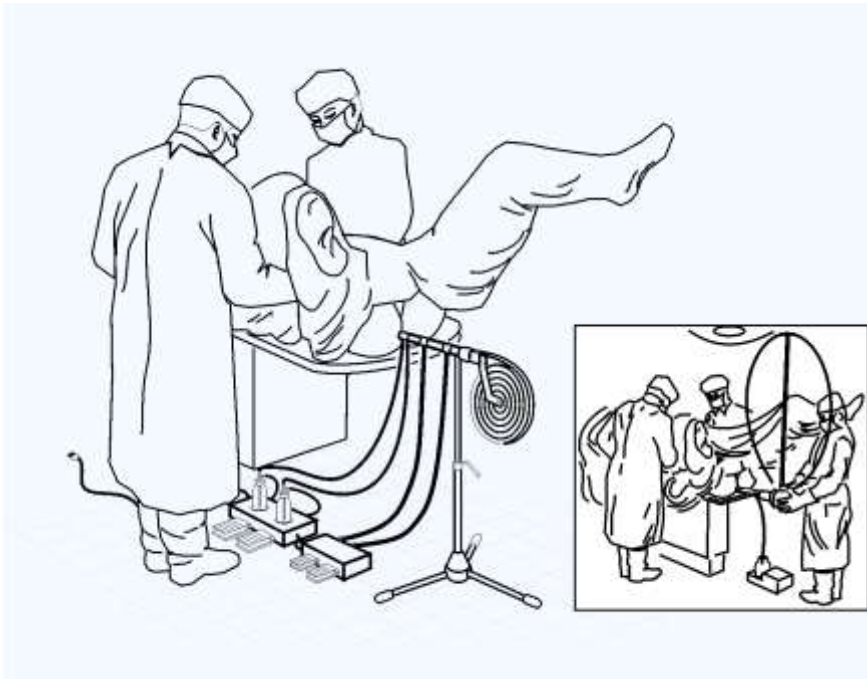


Fig. 66. A probability of uncoordinated manipulations of a surgeon and his assistant during pneumo-manual intestinal intubation (in the box) has stimulated the design of the second device controlled exclusively by a surgeon

Gastric lavage during clinical trials of the first device was rather labour-consuming. In the future, the minimal staff involvement in this multi-day procedure will be secured by a special automatic machine which executes drain recanalization, insertion, removal, a control over the amount of washing liquid.

Manual removal of the invaginator and drain-irrigation elements from the intestine as well as the mechano-pneumatic extubation technique requiring insufflation of air directly into the patient's intestine (Fig. 34) can complicate the post-operative period. For evacuation of the intestine I suggest the mechano-functional extubation technique; staff, involvement in its realization is minimal, special devices are not needed.

Under conditions corresponding to its aim (prophylaxis, treatment of peritonitis and ileus!) the transition to an experimental batch of the «foot» intubator with the drain will take several months. However, available home details, materials and technology, increasing economic crisis in the countries of post-Soviet area will hinder the introduction of the «Intestinal Intubator with the Drain» into practical medicine. Nevertheless, I am full of hope and that is why finish with the words *the end is following...*

SOURCES OF INFORMATION

1. Агафонов С. Риск оплачивает государство. Газета «Известия», 27.06.89, с. 5.
2. Александров В. Б., Милитарев Ю.М., Орешников М.М., Липецкая Л.М., Щербаков А.Н. Применение длинных двухканальных зондов для лечения послеоперационных внутрибрюшинных осложнений. Хирургия, 1974, 10, с. 121-124.
3. Александрович Г.Л., Бояринцев Н.И. Неотложные релапаротомии. Вестник хирургии, 1979, 12, с. 21-26.
4. Александрович Г.Л., Панасьян Ф.Н., Бояринцев Н.И. Интубация тонкой кишки в комплексном лечении больных острым гнойным перитонитом и кишечной непроходимостью. Хирургия, 1979, 8, с.45-48
5. Амбарцумян А.М. Эффективность эксплуатации видеотелевизионной установки в эндоскопическом центре. Вестник хирургии. 1990, 6, с. 128-130.
6. Андросов И.С. О дренировании тонкой кишки при оперативном лечении кишечной непроходимости. Вестник хирургии, 1971, 5, с.40-43.
7. Т.Антонович В. Б., Лыкомина Е.Е. Клинико-рентгенологическая диагностика неспецифического язвенного колита. М., «Медицина», 1976, 153с.
8. Аныкин В.Ф., Крендаль А.П. Способ проведения зонда для энтерального питания с помощью эндоскопа. Хирургия, 1989, 1, с. 109.
9. Арчвадзе В.Ш., Хазарадзе Д.В., Гонджилашвили В.Г., Кордзадзе З.С., Чубабрия И.Г. Устройство для промывания гнойных полостей. Хирургия, 1990, 6, с. 122-123.
10. Бабский Е.Б., Сорин А.М., Давыдов С.Н. Приборы эндорадиозондирования. «Наука», 1975, 176с.
11. Балалыкин А.С. Эндоскопия. Л., «Медицина», 1987, 288 с.

12. Балалыкин А. С., Разживин А. А. Роль колоноскопии в неотложной хирургии толстой кишки. Хирургия, 1989, 4, с. 70-71.
13. Балалыкин А.С., Авалиани М.В., Василенко Ю.В., Шукшина Ч.В., Самсонова Е.Л., Гаркавенко В.А. Оперативная абдоминальная эндоскопия. Хирургия, 1988, 2, с. 62-66.
14. Баринов В.С. Результат лечения тяжелого пареза и эвентрации кишечника после аортобедренного бифуркационного шунтирования. Вестник хирургии, 1989, 11, с. 152.
15. Белов И. Н., Бабовникова В.Т., Данилюк Т.В., Чумак В. Н., Колесник Н.К., Мельников И.Н. Релапаратомия после операций на органах брюшной полости. Хирургия, 1987, 7, с. 123-127.
16. Беляев А.А. Применение кишечной интубации для профилактики и лечения паралитических состояний желудочно-кишечного тракта. Хирургия, 1956, 7, с. 69-73.
17. Беляев А.А., Быстрое Н.В. Опасности и осложнения энтеростомии. Хирургия, 1958, 9, с. 68-73.
18. Беляев А.А. Постоянное отсасывание содержимого через тонкий зонд при желудочно-кишечных стазах. Автореферат диссертации на соискание ученой степени кандидата медицинских наук. Москва, 1962.
19. Беркутов А.Н. Прения по докладу Русанова А.А. «Об острой кишечной непроходимости». Вестник хирургии, 1974, 9, с. 149.
20. Бондаренко В.А., Вандер К.А. О выборе метода питания в хирургической гастроэнтерологии. Вестник хирургии, 1988, 8, с. 117-120.
21. Бочаров К.Я. Устройство для введения лекарственных веществ. Авторское свидетельство СССР №591191, 1978, бюллетень 5.
22. Брискин Б.С., Смаков Г.М., Антонян С.Т. Диагностика и лечение кишечной непроходимости при раке ободочной кишки. Вестник хирургии, 1989, 10, с. 123-125.

23. Бродский Б.Ф., Захарчук И.Я. Лечение послеоперационной спаечной непроходимости кишечника у детей. Хирургия, 1982, 12, с. 106-108.
24. Бродский Б.Ф., Захарчук И.Я. Ранняя релапаротомия у детей. Хирургия, 1983, 2, с. 70-72.
25. Быстрицкий А.Л. Дренирование брюшной полости. Вестник хирургии, 1988, 7, с. 131-134.
26. Величенко В.М., Мартов Ю.Б., Фсдоренко В.А. Оперативное лечение больных распространенными формами перитонита. Вестник хирургии, 1987, 5, с. 38-39.
27. Веллер Д.Г., Нечитайло П.Е. Ошибки и осложнения при дренировании тонкой кишки. Хирургия. 1981, 3, с. 92-94.
28. Веселое В. К., Ряполов И.А., Закройщикова С.Н. Диагностическая ценность видеокколоноскопии. Хирургия, 1989, 7, с. 155.
29. Винник Л.Ф., Житнюк Р.И. Кишечный отсос-дренаж для энтеростомии по И.Д.Житнюку. Вестник хирургии, 1978, 4, с. 132-133.
30. Витебский Я.Д. Очерки хирургии илео-цекального отдела кишечника. М., «Медицина», 1973, с. 112.
31. Вишневский А.А., Лившиц А.В., Вилянский М.П. Электростимуляция желудочно-кишечного тракта. М. «Медицина», 1978, 184с.
32. Волков Б.П., Моисеев А.Ю., Прохорова Т.П. Шинирование тонкой кишки как способ профилактики спаечной непроходимости. Вестник хирургии, 1986, 5, с. 70-73.
33. Воробьев Г.И. Проблемы колопроктологии. Протокол 2275-го заседания хирургического общества Москвы и Московской области от 1 декабря 1988 г. Хирургия, 1989, 8, с. 156-157.
34. Гаджимирзаев Г.А., Арбулиев М.Г., Ашурбсков В.Г., Меджидие Р. Интубация кишечника через гастростому при кишечной непроходимости у детей. Хирургия, 1977, 8, с. 42-45.
35. Гальперин Ю.М. Парезы, параличи и функциональная непроходимость кишечника. М., «Медицина», 1975, 220 с.

36. Гауенс А.Я., Энгелис А.М., Веверис М.М. Трансназальный декомпрессионный зонд и медикаментозная стимуляция моторики кишечника в лечении диффузного аппендикулярного перитонита у детей раннего возраста. Вестник хирургии, 1986, 9, с. 107-109.
37. Гегечкори Ю.А., Поповянц Р.С. Энтеростомия с применением длинной трубки при острой кишечной непроходимости. Вестник хирургии, 1977, 5, с. 55-58.
38. Гегечкори Ю.А., Энтеростомия с интубацией тонкой кишки в комплексном лечении разлитого гнойного перитонита. Вестник хирургии, 1982, 8, с. 44-46.
39. Гершман Г.Б., Ленюшкин А.И. Энтероскопия при хирургических заболеваниях тонкой кишки у детей. Хирургия, 1989, 11, с. 41-46.
40. Гершман Г.Б., Ленюшкин А.И. Опыт применения сочетанной энтероскопии в хирургической клинике. Хирургия, 1989, 11, с. 155.
41. Глушнев В.Д. Производство медицинской техники, состояние, перспективы. Медицинская техника, 1988, 4, с. 3-5.
42. Гольба З., Кутыпа С., Мистерка Ю. Релапаротомия после операций на органах брюшной полости. Хирургия, 1980, 8, с. 84-85.
43. Григович И.Н., Вальдман А.Б., Шуйгин В.Н. Ретроградная интубация кишечника при острых заболеваниях органов брюшной полости у детей. Хирургия, 1979, 11, с. 93-95.
44. Григорьев С.Г., Санагин В.П., Майзлин В.С. Интубация кишечника при перитоните. Хирургия, 1990, 7, с. 136-139.
45. Губсргриц А.Я., Линевский Ю.Б. Болезни тонкой кишки. М., "Медицина", 1975, 208с.
46. Гузеев А.И. Дренирование тонкой кишки у больных перитонитом. Вестник хирургии, 1973, 10, с. 36-40.
47. Гузеев А.И. Пути снижения летальности при перитоните аппендикулярного происхождения. Вестник хирургии, 1982, 8, с. 46-50.

48. Гузеев А.И., Николаенков И.Н. Оказание помощи пострадавшим с травмой живота в условиях районной больницы. Хирургия, 1988, 4, с.77-80.
49. Гузеев А.И. Релапаратомия послеаппендэктомии. Вестник хирургии, 1988, И, с. 56-57.
50. Гурчумелидзе Т.П., Карасев Н.А., Синев Ю.В., Романов Л.В. Назоинтестинальная эндоскопическая интубация в комплексном лечении послеоперационной кишечной непроходимости. Вестник хирургии, 1990,4,0.128-131.
51. Давыдов Ю.А., Смирнов А.П., Михайлов В.П. Устройство и способ вакуум-терапии гнойных лактационных маститов. Хирургия, 1988, 4, с. 131-132.
52. Даренский Д.И., Калганов Г.Д. Длительная перидуральная анестезия в комплексном лечении перитонита. Хирургия, 1979,10, с. 35-38.
53. Дедерер Ю.М. Кишечная интубация через гастростому с целью устранения послеоперационной паралитической непроходимости кишечника. Клиническая хирургия, 1962, 7, с. 41-45.
54. Дедерер Ю.М. О некоторых новых путях снижения послеоперационной летальности при острой кишечной непроходимости. Хирургия, 1965, 3, с. 34-38.
55. Дедерер Ю.М., Овчинников А.В., Судорогин В.Е. Кишечная интубация через гастростому при лечении острой кишечной непроходимости и гнойного перитонита. Вестник хирургии, 1971, 8, с. 10-14.
56. Дедерер Ю.М. Патогенез и лечение острой непроходимости кишечника. М., «Медицина», 1971, 272с.
57. Дедерер Ю.М., Куновский А.В. Наружное дренирование желудочно-кишечного тракта при послеоперационной паралитической непроходимости. Хирургия, 1977, 11, с. 56-61.

58. Демидов Г.И., Сапожков А.О., Гончаренко Н.И., Никольский В.И. Выбор способа декомпрессии кишечника для профилактики и лечения послеоперационной кишечной непроходимости. Вестник хирургии, 1984, 2, с. 39-42.
59. Дешкевич В. С. К вопросу об энтеростомии при желудочно-кишечных стазах. Клиническая хирургия, 1965, 8, с. 69-71.
60. Долецкий С.Я., Бляу О.Р., Пашерстник Л.А., Арапова А.В., Литвинова Р.И. Применение зонда у детей при парезе кишечника. Хирургия, 1973, 9, с. 71-73.
61. Долецкий С.Я., Щитинин В.Е., Балагин В.М., Арапова А.В. Острый аппендицит и его осложнения у детей. Хирургия, 1976, 6, с. 142-149.
62. Долецкий С.Я., Стрекаловский В.П., Климанская Е.В., Сурикова О.А. Эндоскопия органов пищеварительного тракта у детей. М., «Медицина», 1984, 280с.
63. Дорофеев В.Г., Вестфален А.В. Зонд. Авторское свидетельство СССР 990236, 1983, бюллетень 3.
64. Дорофеев В.Г., Вестфален А.В., Барабаш И.Б., Пригожина М.И. Тонкокишечный зонд-дренаж с проводником и способ его применения. Хирургия, 1987, 5, с. 129-132.
65. Дорофеев Г.И., Басе Р.М., Васильев И.В., Вишневский Т.Н., Гриневич В.Б. Опыт применения цветной телевизионной камеры для эндоскопических исследований в гастроэнтерологии. Клиническая медицина, 1987, 8, с. 42-43.
66. Дрейер К.Л., Баиров В.Г., Цыбульский Э.К., Парнес Д.И., Баирова В.С. Лечение аппендикулярного перитонита у детей. Вестник хирургии, 1982, 5, с. 78-82.
67. Ерюхин И.А., Зубарев П.Н. Пути улучшения диагностики и лечения механической кишечной непроходимости неопухлевой природы. Вестник хирургии, 1980, 8, с. 54-59.

68. Ерюхин И.А., Силин Б.Н., Акинчев С.Л. «Фактор риска» в хирургическом лечении рака ободочной кишки. Вестник хирургии, 1981, 6, с. 46-51.
69. Ерюхин И.А. Перитонит. Проблемы и перспективы. Вестник хирургии, 1986, 7 с. 3-7.
70. Ерюхин И.А., Зубарев П.Н., Рухляда Н.В. Декомпрессия тонкой кишки при острой непроходимости кишечника. Вестник хирургии, 1988, 11, с. 15-20.
71. Женчевский Р.А. Спаечная болезнь. М. «Медицина», 1989, 191 с.
72. Житнюк И. Д. Лечение динамической непроходимости при перитоните. Вестник хирургии, 1965, 12, с. 8-11.
73. Житнюк Р.И., Катаева Г.А. Профилактика гиподинамии кишечника после операций на органах брюшной полости. Вестник хирургии, 1974, 5, с. 46-47.
74. Заверный Л.Г., Пойда А.И., Мельник В.М., Надесв С.С. Частота внутрибрюшных осложнений и релапаротомий в раннем послеоперационном периоде. Вестник хирургии, 1990, 3, с. 131-136.
75. Заркешев С.Р. Способ лечения послеоперационных парезов желудочно-кишечного тракта. Хирургия, 1989, 2, с. 113-114.
76. Зиновьев О.И. Эндоскопическая картина слизистой оболочки толстой кишки в норме и при некоторых ее поражениях. В кн.: Актуальные вопросы гастроэнтерологии. Вып. 7, М., 1974, с. 368-373.
77. Зубарев П.Н., Рухляда Н.В., Ивануса С.Я., Ваганов И.А. Опухоли тонкой кишки. Вестник хирургии, 1988, 8, с. 45-48.
78. Зубарев П. Я., Андснко С.А. Общие принципы лечения огнестрельных проникающих ранений живота. Вестник хирургии, 1990, 1, с. 63-65.
79. Зубарев А.В., Литвин А.Г. Диагностические возможности эндоскопической ультрасонографии. Медицинский реферативный журнал, 1989, раздел 17, гастроэнтерология, 8, с. 9-12.

80. Зюбрицкий Н.М. Методы распознавания послеоперационных внутрибрюшинных осложнений. Вестник хирургии. 1989, 8, с. 143-146
81. Зяббаров А. А. Устройство для контрастного рентгенологического исследования полых органов. Авторское свидетельство СССР 240915, 1969, бюллетень 13.
82. Зяббаров А.А. Самонаправляющийся телескопический зонд для исследования кишечника. Сборник научных трудов «Актуальные вопросы рентгенодиагностики и лучевой терапии». Казань, 1972, с. 80-84.
83. Кавай К., Тада М. Визуальная диагностика заболеваний тонкой и толстой кишки. Симпозиум «Эндоскоп-82», 24-25 ноября 1982 г., Москва, НИИ проктологии МЗ РСФСР.
84. Казарян Г.А., Давтян А.Г. Колоноскопия в диагностике и лечении мелких полипов толстой кишки. Хирургия, 1990, 4, с. 67-69.
85. Каншин Н.Н. Лечение гнойного перитонита. Вестник хирургии, 1980, 9, с. 108-113.
86. Кареев И.Д., Терентьев И.Г., Петров А.В., Ефремов В.А. Диагностика и лечение опухолей тонкой кишки. Хирургия, 1990, 4, с. 74-76.
87. Качурин В.С. Наружное дренирование желудочно-кишечного тракта в неотложной хирургии. Вестник хирургии, 1974, 8, с. 19-24
88. Кириллов Ю.Б., Панков В.И. Значение декомпрессии в профилактике посттравматического разлитого перитонита в эксперименте. Вестник хирургии, 1980, 6, с. 93-95.
89. Киркин Б.В., Капуллер Л.Л., Маят К.Е., Веселое В.В., Мушников В.Н. Рак толстой кишки у больных неспецифическим язвенным колитом. Клиническая медицина, 1988, 9, с. 108-113.
90. Клемашев И.О., Дорофеев А.А., Романов В.А., Григорьян О.Н. Интестиноскопия с прицельной биопсией в диагностике

заболеваний тонкой кишки. Советская медицина, 1980, 11, с. 54-57.

91. Ковалев М.М., Рой В.П., Мартынович Л.Д. Послеоперационная спаечная непроходимость кишечника. Вестник хирургии, 1980, 10, с.102-105.
92. Комаров Б.Д., Богницкая Т.Н., Уманская В.В. Состояние научных исследований и перспективы решения проблемы «Острый гнойный перитонит». Вестник хирургии, 1980, 7, с. 3-7.
93. Комахидзе М.Э., Хомерик Г.В., Какоишвили Г.А., Дзnelадзе Л.Т. Ранняя релапаротомия. Хирургия, 1980, 9, с. 85-87.
94. Коморовский Ю.Т., Форисюк Л.Н. Кишечный и брюшинный ирригоаспираторы для эвакуации застойного кишечного содержимого и гнойного экссудата при илеусе и разлитом перитоните. Клиническая хирургия, 1969, 6, с. 82-85.
95. Кононов А.Г., Абдулаев М.А. Эффективно ли назогастральное дренирование в борьбе с парезом после операций на ободочной и прямой кишке? Вестник хирургии, 1987, 9, с. 58-61.
96. Коркелия А., Батанели А. Опыт фонографии брюшной полости в хирургической клинике. «Сабчота сакартвело» Тбилиси, 1973, 46 с.
- 97а. Корчагина В., Лихолитов В. НПО в одном лице, или Что таится в «Черном ящике». «Медицинская Газета», 21 октября 1987 г., с. 2
- 97б. После выступлений «МГ». «НПО в одном лице». Вопрос к Минздраву: сколько ждать ответа? «Медицинская газета», 26 февраля 1988г.
98. Костовский В.А. Способ декомпрессии тонкого кишечника. Авторское свидетельство СССР 506397, 1976, бюллетень 10.
99. Костовский В.А. Устройство для проведения дренажной трубки. Авторское свидетельство СССР 533382, 1976, бюллетень 40.
100. Костовский В.А. Декомпрессия тонкой кишки через цекостомию и илеоцекальную заслонку. Вестник хирургии, 1978, 11, с. 28-31.

101. Кубышкин В.А., Веретенцев В.Н. Кпатогенезу кишечной непроходимости. Вестник хирургии, 1989, 5, с. 130-134.
102. Куркузов О.П., Кузнецов Н.А., Артюхина Е.Г. Профилактика спаечной болезни. Хирургия, 1990, 4, с. 53-57.
103. Латышев В.М. Пари. Газета «Правда», 4 июня 1982, с. 3.
104. Лебзак К.Ф. Трансцекальная интубация тонкой кишки. Вестник хирургии, 1978, 3, с. 44-46.
105. Лоховицкий С.В., Афендулов С.А., Дарвин В.В. Хирургия повреждений ободочной кишки. Вестник хирургии, 1990, 4, с. 53-57
106. Мазуров А.И., Данилов В.А., Новикова Л.И., Флерова Н.М. Телевизионные медицинские эндоскопы. Медицинская техника, 1987, 2, с. 41-46.
107. Мартов Ю.Б., Аничкин В.В. Осложнение интубации кишечника. Вестник хирургии, 1978, 3, с. 128-129.
108. Мартыненко Н.Г. Причины диагностических ошибок опухолей тонкой кишки. Вестник хирургии, 1989, 4, с. 78-80.
109. Матасов С.А. Способ профилактики и лечения спаечной болезни. Авторское свидетельство СССР 561588, 1977, бюллетень 22
110. Матасов С.А. Устройство для исследования полых органов. Авторское свидетельство СССР 762892, 1980, бюллетень 34.
111. Матасов С.А. Кишечный интубатор Матасова С.А. Авторское свидетельство СССР 839553, 1981, бюллетень 23.
112. Матасов С.А. Кишечный интубатор. Авторское свидетельство СССР 897250, 1982, бюллетень 2.
113. Матасов С.А., Ильинский И.М. Морфологические изменения кишечника при его интубации в эксперименте. Хирургия, 1982, 10, с. 42-44.
114. Матасов С.А. Кишечный дренаж. Авторское свидетельство СССР 927254, 1982, бюллетень 18.
115. Матасов С.А. Кишечный интубатор. Авторское свидетельство СССР 1049067, 1983, бюллетень 39.

116. Матасов С.А. Кишечный интубатор. Авторское свидетельство СССР 1055519, 1983, бюллетень 43.
117. Матасов С.А. Кишечный интубатор С.А.Матасова. Авторское свидетельство СССР 1084028, 1984, бюллетень 13.
118. Матасов С.А. Кишечный интубатор. Авторское свидетельство СССР 1377123, 1988, бюллетень 8.
119. Матасов С.А. Кишечный эндоскоп. Авторское свидетельство СССР 1522466, 1989.
120. Матасов С.А. Кишечный интубатор. Авторское свидетельство СССР 1592990, 1990.
121. Махачев М.О., Арбулиев М.Г. Эффективность энтеростомии при механической кишечной непроходимости. Хирургия, 1977, 11, с. 61-64
122. Мельников Р.А., Симонов Н.Н., Правосудов И.В., Гуляев А.В., Мусукаев Х.М., Ковалев В.К., Мосидзе Б.А. Диагностические и такти-ческие ошибки в хирургическом лечении рака ободочной и прямой ки-шок. Хирургия, 1987, 11, с. 146-149.
123. Мейстере У. Врачи и бюрократы. Газета «Атмода», 16 января 1988 г., с. 6.
124. Мирошников Б.И., Тибилов В.Е. Ранняя послеоперационная острая механическая кишечная непроходимость. Вестник хирургии, 1985, 1, с. 123-129.
- 125а. Михалсвич О. Черный ящик. Газета «Советская Латвия», 24 ноября 1986 г.
- 125б. «Советской Латвии» отвечают. «Черный ящик». Газета «Совет-ская Латвия», 15 января 1987г.
126. Мишарев О.С., Котович Л.Е. Декомпрессия тонкой кишки в детской хирургии. Хирургия, 1977, 1, с. 52-56.
127. Мишарев О.С., Троян В.В. Декомпрессия желудочно-кишечного тракта при операциях на органах брюшной полости у детей. Хирургия, 1980, 7, с. 102-105.

128. Мишарев О.С., Троян В.В. Ретроградная интубация тонкой кишки в лечении функциональной кишечной непроходимости у детей. Хирургия, 1982, 8, с. 94-98
129. Муха В. Г. Декомпрессия желудочно-кишечного тракта и энтеральное питание после операций на пищеводе и желудке. Вестник хирургии, 1987, 9, с. 65-66.
130. Напалков П.Н., Мирошников Б.И. Пути снижения летальности от острой кишечной непроходимости. Вестник хирургии, 1973, 11, с. 8-13; 154-155.
131. Непокойчицкий Е.О., Беленков А.В. Влияние сормантола на моторику кишечника. Хирургия, 1978, 1, с. 110-112.
132. Нестеренко Ю.А., Симонснков А.П., Ступин В.А., Федоров А.В. Профилактика и лечение послеоперационного пареза кишечника серо-тонина адипинатом. Хирургия, 1989, 10, с. 152-153
133. Нечай А.И., Островская М.С. Профилактика и лечение функциональной непроходимости кишечника после вмешательств на органах брюшной полости. Хирургия. 1981, 3, с. 7-12.
134. Нечитайло П.Е. Декомпрессия кишечника и стимуляция его моторики в комплексной терапии больных разлитым перитонитом. Ав-тореферат диссертации на соискание ученой степени кандидата медицинских наук. Харьков, 1978.
135. Никитин А.М., Баранов О.Н., Бугин А.М., Ким С.Д. Несостоятельность швов анастомоза при обширных резекциях толстой кишки. Хирургия, 1987, 5, с. 108-111.
136. Олекса А.П. Эластический наконечник-отсасыватель для эвакуации содержимого кишечника при операциях по поводу острой кишечной непроходимости. Новый хирургический архив, 1957, 1, с. 80-82.
137. Олейник В.С., Рябоконт А.В., Чернов А.В. Электростимуляция кишечника при паралитической непроходимости у детей. Хирургия, 1987, 8, с. 128-129.

138. «OLYMPAS». Каталог Медицинские Фиброскопы, 1978, 22 с.
139. Панасьян Ф.Н. Тотальная энтеростомия в комплексном лечении диффузного перитонита. Автореферат диссертации на соискание ученой степени кандидата медицинских наук. Хабаровск, 1974.
140. Панков В.И. Коррекция нарушений моторики желудка и кишечника после операций на органах брюшной полости. Хирургия, 1981, 3, с. 28-31.
141. Пашкевич В.И., Жаркин А.А. Диагностика и лечение злокачественных опухолей тонкой кишки. Вестник хирургии, 1986, 7, с. 48-51
142. Перов Ю.А., Постолов П.М., Попова И.С. Сравнительная оценка методов подготовки толстой кишки к операции. Хирургия , 1987, 1, с.108-115.
143. Петровский Б.В., Савчук Б.Д., Кузнецов Н.А. Современные проблемы хирургии. Хирургия, 1990, 11, с. 159-161.
144. Плевокас П.Ю. Применение кишечного зонда с армирующими кольцами. Хирургия, 1989, 10, с. 115-117.
145. Полиглотов В.И. Управляемый через энтеростому кишечный диализ. Вестник хирургии, 1988, 3, с. 45-50.
146. Помелов В.С., Булгаков Г.А., Лысенко А.О. Пути снижения послеоперационной летальности и частоты гнойных осложнений при опухолях толстой кишки. Хирургия, 1990, 4, с. 98-101.
147. Порембский О.Б., Житнюк Р.И. О ранней спаечной кишечной непроходимости. Вестник хирургии, 1976, 4, с. 29-32.
148. Прусов А.Л., Попандопуло Н.С. Трансназальная интубация тонкой кишки при парезе кишечника. Хирургия, 1983, 2, с. 90-92.
149. Прусов А.Л., Шлябин Ю.И., Маковецкий Е.Г. Управляемая лапаростома при лечении перитонита. Хирургия , 1989, 2, с. 10-13.
150. Рахманов Р.К. Эндоскопия тонкой кишки. Вестник хирургии, 1988, 3, с. 134-136.

151. Резолюция по вопросу «Об острой кишечной непроходимости». Труды XXVI Всесоюзного съезда хирургов. М., «Медгиз», 1956, с. 571, 572.
152. Реут А. А., Шугаев С.Н. Электростимуляция кишечника в послеоперационном периоде. Хирургия, 1979, 10, с. 38-40.
153. Решение съезда по проблеме «Острая кишечная непроходимость». Труды четвертого съезда хирургов Российской Федерации, 1973, с. 456-458.
154. Рокицкий М.Р., Мустафин А.А., Молчанов Н.Н., Порываева В.Н., Гогитидзе Н.Т. Временная концевая илеостомия в неотложной абдоминальной хирургии у детей. Хирургия, 1987, 8, с. 58.
155. Романов В. А., Шалимов В. А. Техника колоноскопии. Хирургия, 1976, 12, с. 36-40.
156. Романенко Н.Я., Сеидов А.П., Колесников А.А., Стороженко Ю.А. Энтеральное зондовое питание больных. Вестник хирургии, 1989, 7. с. 110-111.
157. Рыбинский Г.А., Васильев В.С., Синев Ю.В., Свирчев В.В. Результаты профилактической колоноскопии в условиях многопрофильной больницы. Хирургия, 1986, 4, с. 63-67.
158. Русаков В.И., Гульянц Э.С., Журавлева Н.Н., Лазарев И.А.; Модель функциональной непроходимости кишечника. Хирургия, 1982, 8. с. 102-103.
159. Русяев В.Ф. Проблемы развития медицинской техники в условиях научно-технической революции. Медицинская техника, 1988, 4, с. 33-39.
160. Рябцев В.Г., Ярема И.В., Джейранов Ф.Д., Мезвришвили Г.О., Фильчев М.И. Гемосорбция и эндолимфатическая терапия в лечении пареза кишечника при перитоните и острой кишечной непроходимости. Вестник хирургии, 1990, 3, с. 104-108.
161. Савельев В.С., Буянов В.М., Балалыкин А.С. Эндоскопия органов брюшной полости. М., «Медицина», 1977, с. 247.

162. Савельев В.С., Буянов В.М., Лукомский Г.И. Руководство по клинической эндоскопии. М., «Медицина», 1985, 544 с.
163. Савчук Б.Д., Власова Е.И., Применение импульсных низкочастотных токов при лечении тяжелых парезов кишечника. Вестник хирургии, 1975, 7, с. 32-34.
164. Сапожков А.Ю. Декомпрессия кишечника при лечении огнестрельных ранений живота. Вестник хирургии, 1989, 9, с. 76-77
165. Сеидов В.Д., Гейбуллаев А.А. Применение длительной перидуральной блокады в сочетании с гипербарической оксигенацией и гепарином при динамической кишечной непроходимости. Хирургия. 1988, 2, с.139-143.
166. Сигал З.М., Жижин Ф.С. Внутрипросветная пульсомоторография через декомпрессионную у-образную стому. Вестник хирургии, 1988, 11, с. 20-22.
167. Симич П. Хирургия кишечника. Бухарест, Медицинское издательство, 1979,399с.
168. Синев Ю.В., Кованев А.В., Смольский Б.Г., Пахомова Г.В. Эндоскопическое исследование при острой толстокишечной непроходимости. Хирургия, 1987, 3, с. 27-30.
169. Синев Ю.В., Кованев А.В., Соколинский А.В. Методы заведения зондов в тонкую кишку при эндофиброскопии. Вестник хирургии, 1988, 1, с. 91-92.
170. Смирнова В.И. Чечин В.С., Акопян А.С. Влияние тотального промывания желудочно-кишечного тракта на некоторые регуляторные механизмы водно-электролитного обмена у больных, оперированных на ободочной кишке. Хирургия, 1989, 4, с. 77-79.
171. Степанов Э.А., Красовская Т.В., Ашурбсков В.Т. Интубация желудка и тонкой кишки через гастростому как мера борьбы с динамической непроходимостью. Вестник хирургии, 1974, 7, с. 84-88.

172. Сторожук В.Т., Орехов И.А., Садовский А.Р. Трансанальное проведение зонда в толстую кишку с помощью оригинального устройства. Вестник хирургии, 1990, 10, с. 114-115.
173. Стрекаловский В.П. Основные принципы колоноскопии. Клиническая медицина, 1978, 2, с. 135-140.
174. Стрекаловский В.П., Ханкин С.Л. Эндоскопия тонкой кишки. Хирургия, 1978, 9, с. 142-145.
175. Стрекаловский В. П. Ханкин С.Л. Илеоскопия. Вестник хирургии, 1978, 10, с. 24-28.
176. Стрекаловский В.П., Колесникова Г.Д., Араболинский В.М. Энтероскопия. Симпозиум «Эндоскоп 82», 24-25 ноября 1982 г., Москва, НИИ проктологии МЗ РСФСР.
177. Стрекаловский В.П. Эндоскопия в проктологии. Хирургия, 1983, 3, с.92-97.
178. Стрекаловский В.П. Перспективные направления в развитии эндоскопических исследований органов пищеварительного тракта. Медицинская техника, 1985, 3, с. 22-25.
179. Стрекаловский В.П., Никитин А.М., Ежева Г.И., Демьянов В.Н., Кальянов А.В. Эндоскопическое удаление полипов тонкой кишки при тотальном полипозе пищеварительного тракта. Вестник хирургии, 1986, 12, с. 36-39.
180. Стручков В.И. Острая кишечная непроходимость и пути снижения летальности при ней. Труды XXVI Всесоюзного съезда хирургов. М., 1956, с. 445-456.
181. Ступин В.А., Федоров А.В., Симоненков А. П. Профилактика и лечение послеоперационного пареза кишечника серотонин-адипинатом. Хирургия, 1989, 3, с. 113-115.
182. Сумин В.В., Жижин Ф.С. Лечебно-декомпрессионная У-образная стома при резекции кишки. Вестник хирургии, 1986, 12, с. 81-86
183. Тада М., Тоояма Ё, Танака Ё, Симидзу Т., Фудзий Х., Миёси М., Нисимура С., Ниситани Т., Сикатакэ К., Ямамото М., Акасака Ю.,

Кавай К. Разработка нового интестинофиброскопа 551Р типа V. Симпозиум «Эндоскоп-82», 24-25 ноября 1982 г., Москва, НИИ проктологии МЗ РСФСР.

184. Татишвили Г.Г., Гамазашвили Т.Ш. Энтеральное зондовое питание после экстренных операций на органах брюшной полости. Хирургия, 1986, 4, с. 54-59.
185. Тетдоев А.М., Поляков А.В. Хирургическая тактика при раке толстой кишки, осложненной кишечной непроходимостью. Хирургия, 1990, 4, с. 64-67.
186. Толочко С.А., Розснберг М.И., Демченко А.А., Жуков А.О., Костюченко Б.М., Звягин А.А., Сироткина Н.Н., Ханьков Ю.А., Рябов Б.Я. Приборный комплекс для проведения энтерального питания. Медицинская техника, 1989, 1, с. 43-46.
187. Толстых П.И., Гостищев В.К., Макушкин Р.З., Василькова З.Ф. Дренирование в брюшной хирургии. Хирургия, 1987, 7, с. 135-140
188. Толстых П.И., Юнус Ю.М., Макушкин Р.З., Дербенев В.А., Сторожук В.П. Хирургический дренаж в лечении послеоперационных ран и полостей. Хирургия, 1989, 5, с. 133-139
189. Топчибашев М.А., Буртиков Т.А. Илеостомия при стойком парезе и параличе кишечника. Хирургия, 1977, 11, с. 64-65.
190. Ульянов В.И., Варюхин А.С. Хирургическое лечение рака толстой кишки. Хирургия, 1983, 3, с. 59-62.
191. НаттегзсЫац А. Энциклопедия практической медицины. Том 2. С-Петербург, Брокгауз-Ефрон, 1907, с. 1566.
192. Хромов Б.А. Анатомия собаки. Ленинград, 1972.
193. Химичев В.Г., Шорлуян П.М., Тенчурин Ш.А. Об эффективности прерывистого активного дренирования. Вестник хирургии, 1983, 1, с. 66-67.
194. Цацаниди К.Н., Пугаев А.В., Крендаль А.П., Федорко Н.А., Токаев Э.С. Эндоскопическая установка еюнального зонда и

методика про-ведения энтерального питания специальными смесями. Вестник хирургии, 1987, 7, с. 61-65.

195. Цацаниди К.Н., Федорко Н.А., Манукян Г.В. Энтеральное зондовое питание у хирургических больных. Хирургия, 1988,11, с. 124-131.
196. Цибик А.И., Шебуев М.Г. Ранний послеоперационный илеус. Клиническая хирургия, 1970, 9, с. 22-24.
197. Чазов Е.И. О сосоянии и перестройке медицинской науки в свете выполнения решения январского (1987 г.) Пленума ЦК КПСС. Вестник АМН СССР, 1987, 11, с. 4-11.
198. Чхеидзе М.Я. О преимуществе энтеростомии длинной дренажной трубки. Хирургия, 1970,10,с.118-119.
199. Шальков Ю.Л., Нечитайло П.Е., Гришина Т.А. Метод декомпрессии кишечника в лечении функциональной кишечной непроходимости. Вестник хирургии, 1977, 2, с. 34-38.
200. Шальков Ю.Л., Колбландин С.Н. Дифференцированный подход к восстановлению моторной функции кишечника при перитоните. Вестник хирургии, 1986, 4,с.42-45.
201. Шанин С.С. Длительная перидуральная анестезия как компонент интенсивной терапии больных с повреждениями органов живота. Вестник хирургии, 1982, 4, с. 119-121.
202. Щербаков А. А. Применение кишечных зондов для профилактики и лечения послеоперационных внутрибрюшинных осложнений. Хи-рургия, 1974, 12, с. 91-96.
203. Щитинин В.Е., Арапова А. В. Декомпрессия желудочно-кишечного тракта при перитоните и непроходимости кишечника у детей. Хирургия, 1978,3, с. 124-127.
204. Штрапов А.А., Рухляда Н.В. Энтеральная дезинтоксикация у больных с перитонитом и острой кишечной непроходимостью. Вестник хирургии, 1986, 5, с. 32-35.

205. Шуркалин Б.К., Кригер А.Г., Линденберг А.А., Мехтиев Р.И. Диагностика и лечение послеоперационного перитонита. Хирургия, 1987, 1, с. 87-90.
206. Шуркалин Б.К., Кригер А.Г., Чугунов А.О. Полуоткрытый и открытый методы лечения распространенного гнойного перитонита. Хи-рургия, 1989, 2, с. 7-10.
207. Schule A. Энциклопедия практической медицины Том 2. С-Пе-тербург, Брокгауз-Ефрон, 1909, с. 463.
208. Эндер Л.А., Савельев В.С., Эндер Л.А, Шуркалин Б.К., Коншин Н.Н., Филимонов М.И., Брискин Б.С. Дискуссия по докладу Савчука Б.Д. "Хирургическое лечение распространенного перитонита". Протокол 2239-го заседания хирургического общества Москвы и Московской области от 5 февраля 1987 г. Хирургия, 1988, 2, с. 149-150.
209. Эндер Л.А., Филижанко В.Н., Ватазин А.В., Карпова Е.Г. Де-монстрация больного после проникающего ранения брюшной полости с множественными повреждениями подвздошной кишки. Протокол 2265-го заседания хирургического общества Москвы и Московской области от 19 мая 1988 г. Хирургия, 1989, 4 с. 148-149.
210. Юликов С.А. Герег А.В., Гидирим Н.П., Бреништер И.С. Эндо-скопическая диагностика и лечение аденом толстой кишки. Вестник хирургии , 1987, 5,с. 73-74.
211. Юсупов Ю.Н., Епифанов М.В. Активное дренирование раны. Вестник хирургии, 1987, 4, с. 42-46.
212. Яновой В.В. Жуков О.И. Кривша Ю.В. Полное кишечное промывание в комплексном лечении несостоятельности толстокишечных анастомозов. Вестник хирургии, 1987, 8, с. 48-50
213. Banes A.V., Yamanishi P., Crans Ch.A. Endoscopic colonic decompression of toxic megacolon, placement of colonic tube, and steroid colonclysis. Amer. J. Gastroenterol., 1987, 82, 7, 692-694.

214. Bayeli P.P., Abate L., Croci P. Studio e controllo morfologico della colite ulcerosa. *Minerva dietol. gastroenterol.*, 1987, 33, 2, 137-140.
215. Barillari P., Ramacciato G., Valabrega S., Gozzo P., Indinnimeo M., De Angelis R., Fegiz G. 11 Colorectal Cancer in Young Patients. *Int. Surg.* -1989. - Vol. 74, 4. - P. 240-243.
216. Barry M.J., Mulley A.G., Richter J.M. Effect of workup strategy on the colt - effectiveness of fecal occult blood screening for colorectal cancer. *Gastroenterology*, 1987, 93, 2, 301-310.
217. Benfield G.F.A., Montgomery R.D., Asquith P. Ulcerative colitis in Asian immigrants. *Postgrad. med. J.*, 1987, 63, 742, 629-636.
218. Bories C. Acquisitions recentes dans les cancers colo-rectal. *Rev. franc. Gastroenterol.*, 1988, 24, 240, 890-891.
219. Brendler S.J., Tolle S. W. Fecal occult blood screening and evaluation for a positive test. *West. J.Mel.*, 1987, 146, 1, 103-105.
220. Brostrom O., LofbergR., Nordenvall B., OstA., Hellers G. The risk of colorectal cancer in ulcerative colitis. An epidemiologic study. *Scand. J. Gastroenterol.*, 1987,22, 10, 1193-1199.
221. Champault G. L'ileus post-operatoire. Mesure des variations de pression intra-gastrique au decours immnetiat d'interventions abdomonales (Deductions pratiques). *J. Chir (Paris)*, 1975, 109, 4, 409-428
222. Chen Y.L. The diagnosis of colorectal cancer with cytologic brushings under vision at fiberoptic colonoscopy. A repot of 59 cases. *Dis Colon Rectum*, 1987, 30, 5, 342-344.
223. Copi R. Les investigation endoscopiques ambulatoires.*Rev. Prat. (Paris)*, 1988, 37,59-60.
224. CunsoloA., Arena N., RanieriM.L., SpolaoreR., GorrettiG. Tumori primitivi del tenue. *Minerva chir.*, 1988, 43, 11, 923-928.
225. DayalH., Polissar L., YangC.Y., DahlbergS. Rase, socioeconomic status, and other prognostic factors for survival from colo-rectal cancer. *J. chron. Dis.*, 1987, 40, 9, 857-864.

226. Des Marez B., Adler M., Buset M., Ansay J., Delcour C., Jeanmart J., Finne R., Cremer M. The value of colonoscopy in the diagnosis and management of severe hematochezia. *Acta endoscopica*, 1988, 18, 4, 241-244.
227. Dirks E. Goebell H., Eigler F.W. Verlauf und Prognose der Colitis ulcerosa. *Med. Klin.*, 1989, 84, 4, 208-215.
228. Domergue /., Ismail M., Astre C., Rouanet P., Pujol H. Cancers colorectaux de l'adulte jeune: les raisons du mauvais pronostic. *Ann. Chir.* - 1989. - Vol. 43, 6. - P. 439-442.
229. Dwyer D.M., Klein E.G., Istre G.R., Robinson M.G., Neumann D.A., McCoy G.A. Salmonella newport infections transmitted by fiberoptic colonoscopy. *Gastrointest. Endosc.*, 1987, 33, 2, 84-87.
230. Elliot M.S., Levenstein I.H., Wright I.P. Faecal occult blood testing in the detection of colorectal cancer. *Brit. J. Surg.*, 1984, 74, 10, 784-786
231. Frexinos J. Troubles fonctionnels intestinaux; aspects cliniques et therapeutiques actuels. *Rev. Prat.*, 1988, 38, 4, 229-234.
232. Fochios S.E., Korelitz B.I. The role of sigmoidoscopy and rectal biopsy in diagnosis and management of inflammatory bowel disease: Personal experience. *Amer. J. Gastroenterol.*, 1988, 83, 2, 114-119.
233. Frommer D.J., Kapparis A., Brown M.K. Improved screening for colorectal cancer by immunological detection of occult blood. *Brit. med. J.*, 1988, 296, 6629, 1092-1094.
234. Gagata C., Klukowski M., Ancyparowicz S., Kawalski A. Wskazania do srynowania jelit w ich niedroznosci i zapaleniu otrzewnej. *Pol. Przegl. chir.*, 1988, 60, 1, 16-24.
235. Galibert Cl. Intubation per-operatoire du grele dans le traitement des occlusions intestinales primitives ou recidivantes. "*Ann. Chir*", 1979, 33, 1, 26-31.
236. Gueroult N. Coloscopie ou lavement baryte? *Rev. Prat. (Paris)*, 1988, 38, 69-70.

237. Habib N.A., Dawson P.M., Peck M.A., Braxland J.W., Luck R.J.
Local recurrence of colorectal cancer. A district general hospital's
experience. Brit. J. clin. Pract., 1988, 42, 6, 225-227.
238. Hardcastle J.D., Chir M., Pyc G. Screening for colorectal cancer:
critical review. Wld J. Surg., 1989, 13, 1, 38-44.
239. Herzog V. Kolonlipome. Coloproctology, 1089, 11,2, 71-74.
240. Hollender L.F., Meyer Ch., Bur P., Chanthavinout H. Les occlusions
mecaniques du grele. Tactique operatoire et indications de la
mesenterico-plicature selon Childs et Phillips. Montpellier chir.,
1974., 20, 3, 191-203.
241. Kapral W. Taktik und Ergebnisse beim postoperativen Fruhileus.
"Akt. Chir", 1977, 12, 2, 117-126.
242. Karaus M., Sarna S.K., Amman H. V., Wienbeck M. Effects of oral
laxatives on colonic motor complexes in dogs. Gut, 1987,28, 9,
1112-1119.
243. Karaus M., Wienbeck M. Diskdarmmotilitat // Fortschr. Med. -1989.-
Bd. 107, 16.-s. 44-54.
244. Kormann G., WuttkeCh. TransnasaleDunndarmschienungbei Ileus
und Peritonitis. Zbl. Chir., 1983, 108, 15, s. 984-991
245. Kramann, Bernhard. Medizinisches Gerat mit Einfuhrungshilfe.
Deutsches Patentam, Patentschrift DE 3329176 Cl, 1984.
246. Krige J.E.J., Hudson D.A., Kotller R.E. Acute colonic pseudo-
obstruction. Current diagnosis and management. S. Afr. med. J.,
!989, 75, 6,271-274.
247. Lambert R., SouquetJ.C., Valette P./L'endosonographie digestive
en 1988. Principes et perspectives. Gastroenterol clin. Biol., 1988,
12, 4, 376-386.
248. Leighton Stephen B., Boyd William H. Everting tube device with
relative advance control. United States Patent 4.321.915., 1982.
249. Lewis B.S., Waye I.D. Total small bowel enteroscopy. Gastrointest.
Endosc., 1987,33, 6,435-437.

250. Lubat E., Balthazar E. J. The current role of computerized tomography in inflammatory disease of the bowel. *Amer. J. Gastroenterol.*, 1988,83, 2. 107-113.
251. Mann C.V., Gallagher P., Frecker P.B. Rigid sigmoidoscopy : An evaluation of three parameters regarding diagnostic accuracy. *Brit. J. Surg.*, 1988,75, 5,425-427.
252. Mont A., Bokey E.L., Chapuis P.M., Killiangback M., Hughes W., KooreySt. G., Cook I., Goulston K.J., Dent O.F. Rectal bleeding. Do other symptoms aid in diagnosis? *Dis Colon Rectum*, 1989, 32, 3, 191-195.
253. Meessen J.P., Jouret-Mourin A., Vanheuverzwijn R., Jungers M., Fiasse R., Hoot J. Apport des biopsies rectales et coliques dans le diagnosis de la maladie de Crohn. *Acta gastroenterol.*, 1987, 50, 2, 211-217.
254. Meiser G., Meissner K. Ileus and intestinal obstruction - Ultrasonographic findings as a guideline to therapy. *Hepato-gastroenterologica*, 1987,34, 5, 194-199.
255. Meissner K. Gastro-entero-zokale Darmschienung. Vorlaufiger Erfahrungsbericht mit einer neuen Modifikation. «Zbl. Chin», 1976, 101, 1,35-38.
256. Meissner K. Moglichkeiten und Grenzen der konservativen leusbehandlung. Erfahrungswerte aus 27 Behandlungsfallen, mit Hilfe endoskopisch gelegter Miller-Abbott-Sonden. «Langenbecks Arch. Chir.», 1978,346, 4,239-253.
257. Nishida T., IidaM., ChijiwaK., MoriM., FujishimaM. Obstructive colitis; Endoscopic diagnosis using a pediatric colonofiberscope. *Gastrointest. Endosc.*, 1988,34, 2, 140-141.
258. Neugut A.I., Pita S. Role sigmoidoscopy in screening for colorectal cancer: A critical review. *Gastroenterology*, 1988, 2, 492-499.
259. Neugut A.I., FordeK.A. Screening colonoscopy: Has the time come? *Amer. J. Gastroenterol.*, 1988, 83, 3, 295-297.

260. «OLYMPUS» (catalog). Endoscopic Video Information Sistem. Videomage Endoscope. 1987.
261. Ottenjann R. Gastroenterologische Endoskopie. Aktuelle Aspekte und Perspektiven. Dtsch. med. wschr., 1986, 113, 4, 152-154.
262. Pajares Garcia, Rodriguez Munoz J.M., Mate Jimenez S. Prevalencia de la enfermedad de Crohn en la zona Central de Espana (ambas Gastillas, La Mancha, Cantabria y Rioja): Estudio epidemiologico cooperative de la Asociacion Castellana de Aparato Digestive (A.C. A.D.). Rev. esp. Enferm. Apar. digest., 1987, 71, 4, 313-317.
263. Parithivel V.S., Pandya G.P., Gerst P.M. Wich One First? Barium Enema or Colonoscopy // Amer. Surg. - 1989 - Vol 55, 7, P. 417-420
264. Porowska B., Flati G., Tuscano D., Chianelli M.L., Cossetti F., Faj F., Hidalgo M. Ileoscopia. Indicaciones y resultados. Rev. esp. Enferm. Apar. digest., 1988, 74, 3, 225-230.
265. Pricolo V.E., Vittimberga G.M., Ycllin S.A., Burchard K. W., Slotman G.J. Decompression after Gastric Surgery. Gastrostomy Versus Nasogastric Tube. Amer. Surg. - 1989.- Vol. 55, 7, P. 413-416.
266. Prior A., Lessells A.M., Whorwell P.J. Is biopsy necessary if colonoscopy is normal? Digest. Dis. Sci., 1987, 32, 7, 673-676.
267. Reichert B., Putzki H., Kolorectale Endometriose. Chir Prax., 1988, 39, 1, 31-37.
268. Ridler L. Zum Problem postoperativer Kominationen nach Dickdarmoperationen wegen maligner Tumoren. -Zbl. Chir., 1977, vol. 102, 4, s. 236-242.
269. Rogers I., Misiewicz I.I. Fully automated computer analysis of intracolonic pressures // Gut. - 1989. - Vol. 30, 5. - P. 642-649.
270. Rosen A.M., Fleischer D.E., Lowel G.I. bleeding: Updated diagnosis and management. Geriatrics, 1989, 44, 3, 49-60.

271. Rossini P.P., Ferrari A., Spandre M., Cavallero M., Gemme C., Berton A., Pintor M.P. Emergency colonoscopy. *Wld J. Surg.*, 1989, 13, 2, 190-192.
272. "RUSCH" (katalog). Teil HI/2 Gastroenterologie Chirurgie Drainagen. 1970,45.
273. "RUSCH" (katalog). Teil HI/6 Gastroenterologie Chirurgie Drainagen. 1985, 19.
274. Sabater P.A., Gonzales A.I., Sancho C.C., Cortina G.P. Evolucion de la mortalidad por cancer colorrectal en Espana durante. *Rev. esp. Enferm. digest.*, 1988,73, 3,244-248.
275. Schapiro M., Auslander M.O., Schapiro M.B. The electronic video endoscope: Clinical experience with 1200 diagnostic and the rapetic cases in the communiti hospital. *Gastrointest. Endosc.*, 1987, 33, 2, 63-68.
276. Shigematsu A., Iida M., Hatanaka M., Kohrogi N., Matsui T., Fujishima M., Itoh H., Fuchigami T., Iwashita A. Endoskopie diagnosis of lymphangioma of the small intestine. *Amer. J.Gastroenterol.*, 1988, 83, 11, 1289-1293.
277. Shimizu S., Tada M., Kawai K. Development of a new insertion technique in push-type enteroscopy. *Amer. J. Gastroenterol.*, 1987, 82, 9, 844-847.
278. Silverman D. Medical instrument for everting a thinwalled flexible tubing. *United States Patents*, 3.506.011., 1970.
279. Silverstein F.E. The future of video endoscopy. *Gastrointest. Endosc.*, 1988,34, 4,361-362.
280. Spiller R.C., Brown M.I., Phillips S.F. Emptying of the terminal ileum to intact humans. Influence of meal residue and ideal motility. *Gastroenterology*, 1987, 92, 3, 724-729.
281. Stutzer H. Komplikationen bei der inneren Darmschienung mil der Miller-Abbott-Sonde. «Akt. Chir.», 1976, 4,243-246.

282. Terrazas Hontanón J.M., Buelta-Carrillo L., Val-Bernal J.F. Complicaciones digestivas del carcinoma del colon y recto y su relación con el pronóstico. Rev. esp. Enferm. Apar. digest., 1988, 73, 5-II, 575-579.
283. Waye I., Dewis B.S. Gastro-intestinal bleeding: The small bowel. A diagnostic approach. ItalJ. Gastroenterol., 1988, 20, 2, 74-77.
284. Whelan R.L., Buls G., Goldberg S.M., Rothenberg C. Intra-operative Endoscopy University of Minnesota Experience. Amer. Surg., 1989, Vol 55, 5, p. 281-286.
285. Wytock D.H., Baybick J. Depth of colorectal biopsies with proctoscopic forceps. Gastrointest. Endosc., 1987, 33, 1, 15-17.
286. Zornig C., Klom.pH.-I. Das Dunndarmcarcinom // Chirurg. - 1989. - Bd 60, H. 9. - S. 603-606.

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