S.A. Matasov

Prospects of CRC endoscopic screening.

Part 3

Amanual method of intubational colonoscopy

"Level of serious complications from colonoscopy screening is 10 times higher than from others widely used cancer screening tests" [1]

Contents of slides

1. Incomplete colonoscopy and other colon cancer (CRC) screening deficiencies

"There are no meanwhile any direct proofs, that screening colonoscopy reduces mortality rate. It is not also clear, whether is compensated the complexity, inconvenience and cost of colonoscopy procedure" [2]

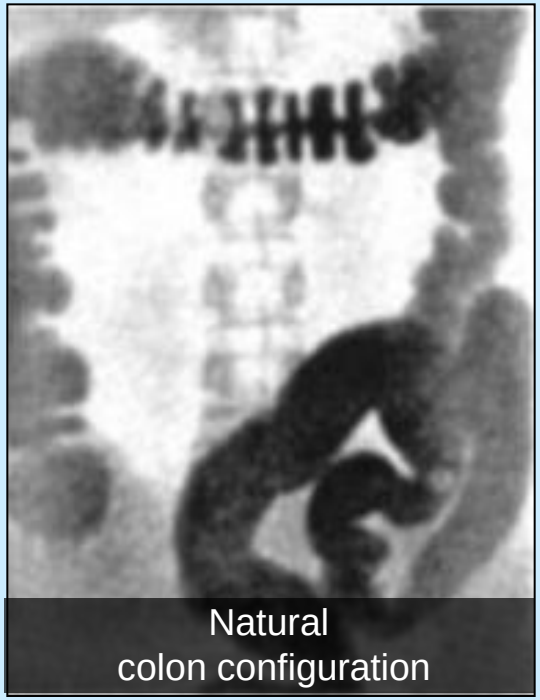
"The presence of at least one of four colonoscopic factors from a previous colonoscopy (incomplete colonoscopy, bad preparation of intestine, incomplete polyp's removal, lack of surveillance colonoscopy within 5 years) accounted for 41,1% of colorectal cancers, whereas presence of at least one of four polyp factors accounted for only 21,7%: size 1 cm and more, villous components or high-grade dysplasia, and the presence of at least 3 polyps or at least 1 proximal polyp" [3].

Frequency of examination of the whole large bowel was adequately estimated on 20.085 colonoscopies, made by 2.681 endoscopists: *"Unfortunately in the United Kingdom a complete colonoscopic examination to the caecum is achieved in only 70% of cases"* [4].

This data allow to confirm, that the real guilty in *incomplete colonoscopy* are not doctors, but manufacturers of colonoscopes.

2. Manual colonoscope. Condition of complete intubation

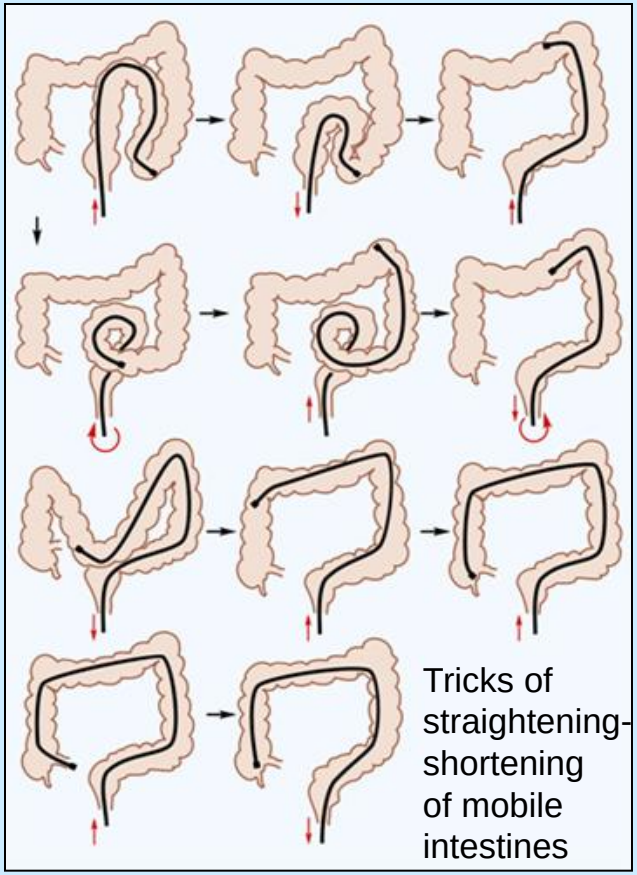
1,6-meter long endoscopic tube is introduced by hand; such 1-forced intubation requires straightening-shortening of mobile intestines. Endoscope, absorpted by stretched sigmoid or transverse intestine, will never reach caecum. Straightening-shortening is among the reasons, which cause the risk of omission of 32.8% of polyps and 31.4% of adenomas [5].



Natural colon configuration

Complete colonoscopy – endoscope reached of caecum

Achievement of caesum reduces colon curves by 3-4 times, and shortens its axis till 70-80 cm; the procedure is realized by hand, by progressive-returnable and rotary movements of endoscope [6].



Tricks of straightening-shortening of mobile intestines

3. Manual colonoscope. Risks of intubational trauma.

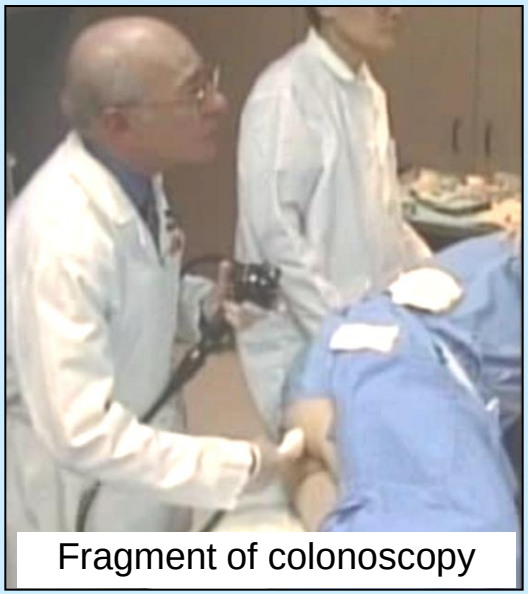
Straightening-shortening of intestines stretches their wall and mesentery, generates pain and trauma. Microtrauma of mucosa pose the risk of cross-infection of patients (see Prospects, section 2.1), bleeding, and other serious complications occurs 1 on 200 colonoscopies [7]; perforations during diagnostic examination reach 0.8% [8]. Direct proof of the imperfection of manual colonoscopy - rejection of it; in Germany, for example, CRC held annually only 3-4% of seniors [9].

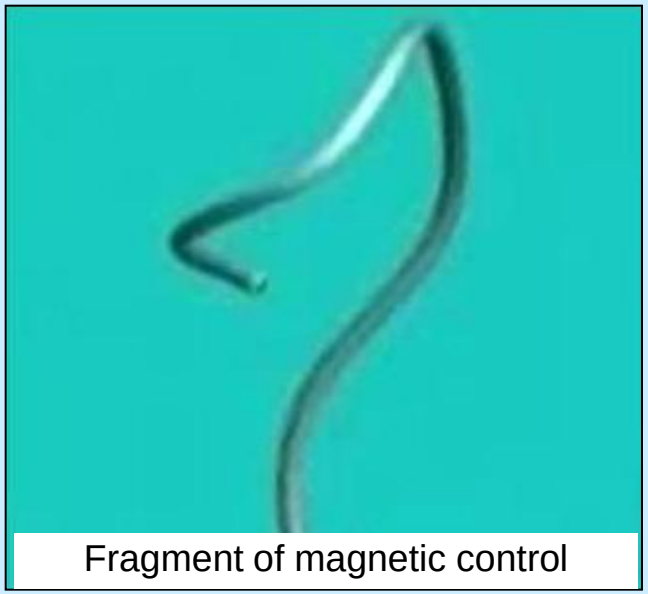
4. Manual colonoscope. Difficulties of mastering, risk of sedated intubation

Colon straightening-shortening is mastered on patients; in 1st year caecum is reached in 56-75% [10]. Here is interesting note: *"Prof. told that after 5 thousands of colonoscopies I will steer ... as he does"* [11]. However the art of colonoscopy which gives 90-98% full intubations [12,13], requires 10 thousands hours of "self-training" [6] - about 20 thousands of procedures.

Deep sedation of manual intubation, which is used today for colonoscopy almost everywhere, somewhat facilitated straightening-shortening of colon, but deprived patient of defensive reaction, thus increased in 2,6 times the number of perforations [14].

Safety and quality of manual intubation is estimated according the records of: manipulations of doctor, magnetic control of endoscope's move, examination of mucosa [15].

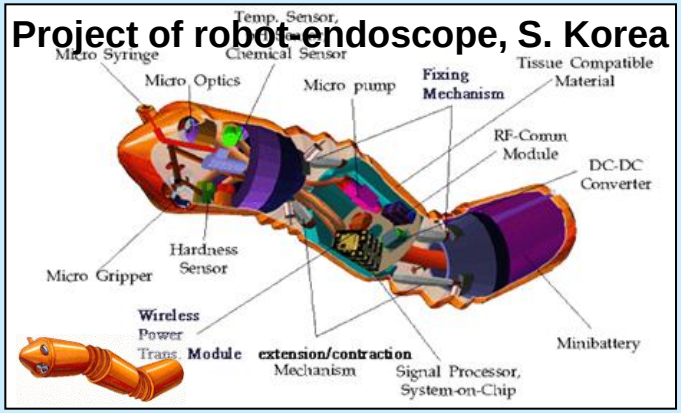

Fragment of colonoscopy


Fragment of magnetic control


Fragment of mucosa record

5. Manual colonoscope. Search of alternative

For the search of new means for examination of large bowel [16] were spent hundreds of millions dollars, but there is no result: autonomous devices, for example, endoscopic capsule - are uncontrollable, the tubular - does not guarantee complete intubation or, as well as manual colonoscope, require individual intubation skill.



6. Requirements to colonoscope for CRC screening

Adequate colonoscope should be, primarily ergonomic, that is: new colon intubation should be accessible to any doctor.For patients intubation should be:

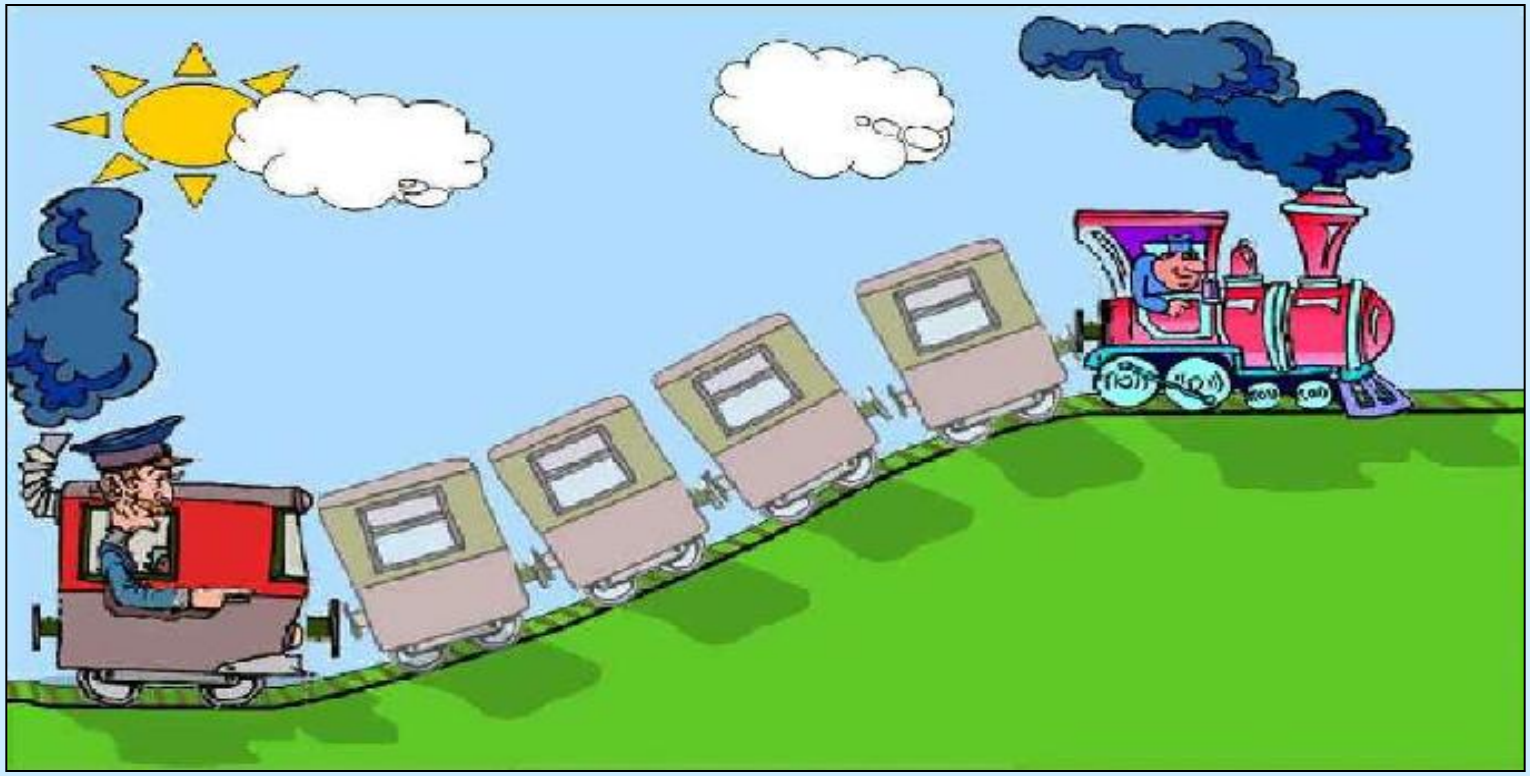
- atraumatic and painless – without sedation and anesthesia,
- complete and proportionate – without straightening-shortening of mobile intestines.

Besides, an adequate colonoscope should:

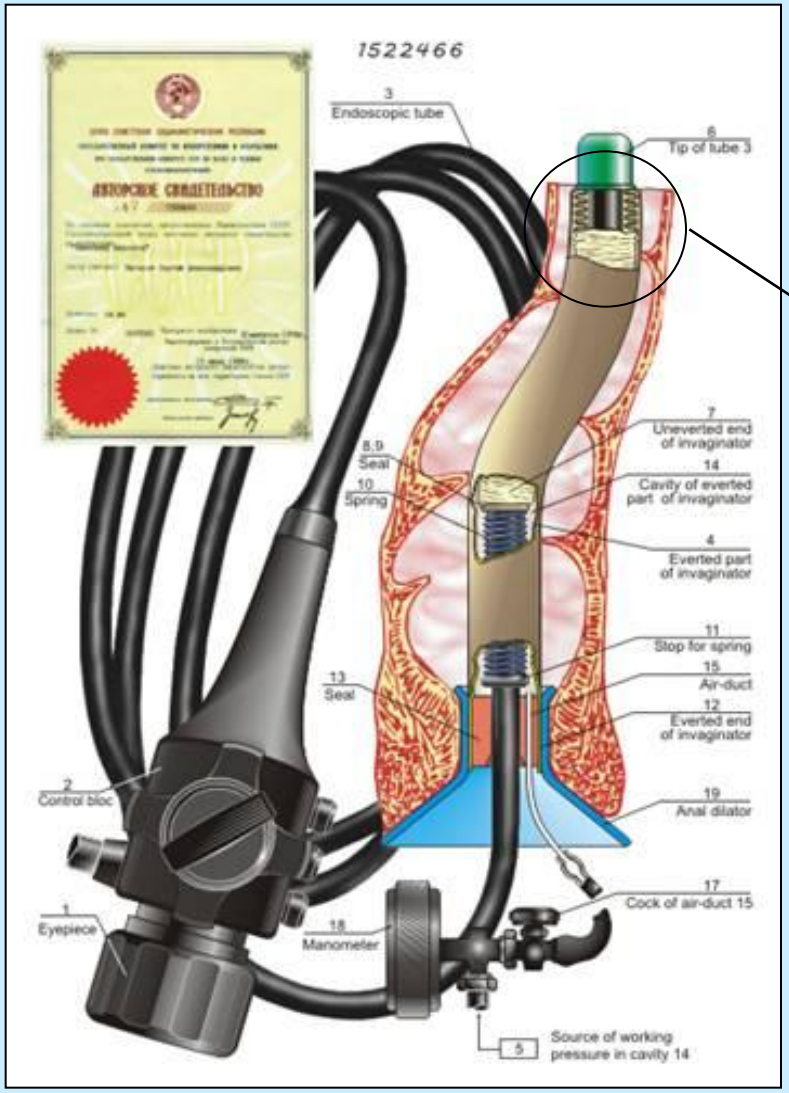
- provide biopsy and other endoscopy operations,
- exclude cross-infection of patients (see Prospects, part 2.1, Aseptic method of infection safety of flexible endoscopy).

7. Physics of intubation

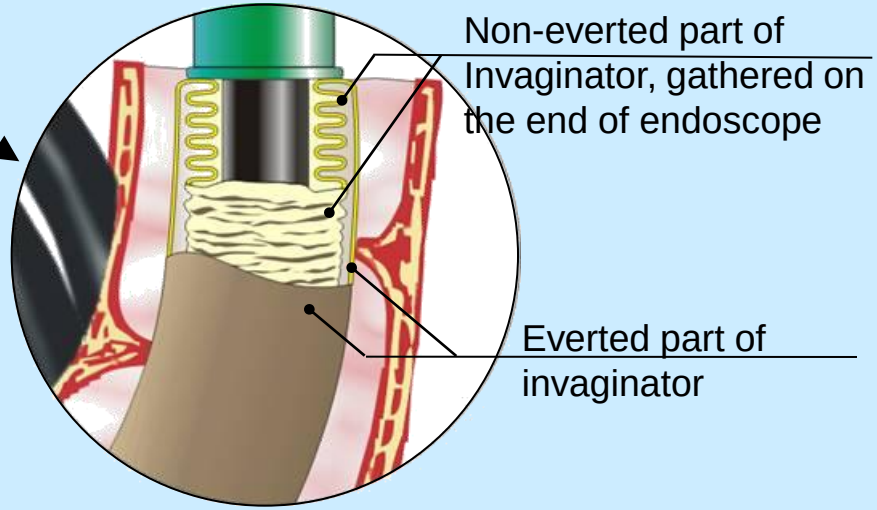
Formulae of L.Euler $Q_1/Q_2=e^{\alpha f}$ defined the reason of difficulties of large intestine's intubation. This is - the value α: bends of large intestine's channel reaches about 1000°. Reducing of the number of bends by manual straightening-shortening of intestines is not accessible to all, is not reliable, carries the risk of injury. Analysis of Interaction between factors of the formula, allowed us to offer an alternative type of intubation – according the "push-and-pull" principle.



8. Two-forced colonoscope



The first «push-and-pull» colonoscope was applied by S.A. Matasov in 1978 – see on the web-site of the European Patent Office [17].



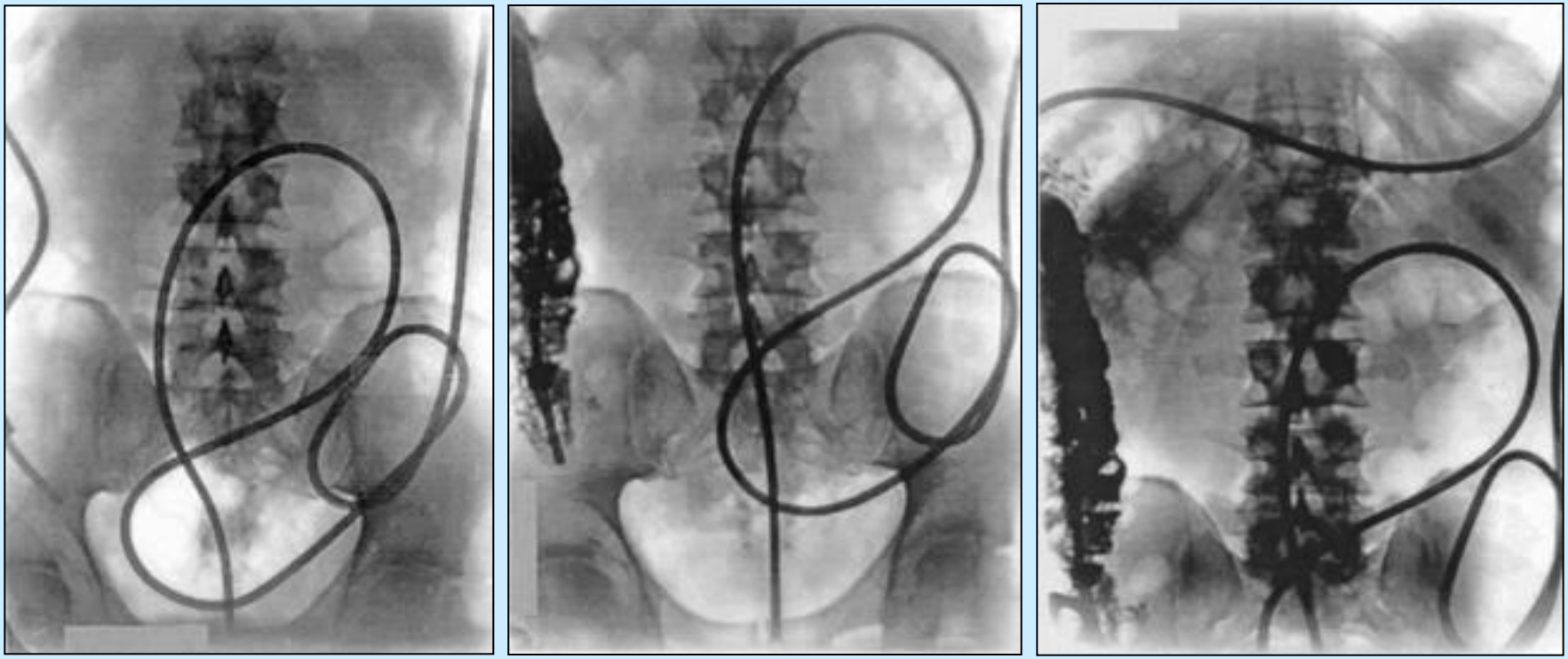
Its force «pull» is generated by invaginator – thin-walled sleeve, being everted by the air pressure as the finger of surgeon's glove (see slide 9); the force «push» - by the hand of endoscopist. On the basis of intubation forces, the first two-forced colonoscope should be classified as the pneumo-manual one.

9. Two-forced colonoscope. Maintenance of atraumatic intubation

Due to invaginator's evertion and rolling on mucosa of large intestine, the two-forced colonoscope is an atraumatic mean.

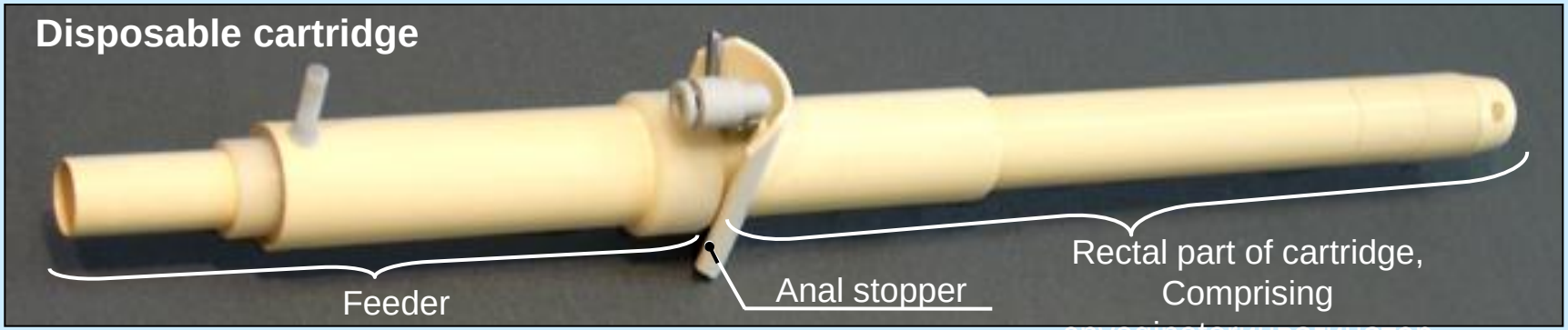
10. Two-forced colonoscope. Maintenance of proportionate and complete intubation

Testings of «push-and-pull» system on humans have showed: 1) ergonomics of intubation – it was realised by colleague without endoscopic experience; 2) possibility of complete and proportionate colon intubation – see roentgenogramms; 3) painlessness of intubation – volunteers does not feel nor the beginning, neither the progress or finishing of intubation.



Roentgenogramms, fixing the first testing of two-forced intubation system. On the left – the complete intubation of arge intestine, in the center and on the left – the same plus selective contrasting of caecum and ascending colon.

11. Two-forced, self-propelled colonoscope



The second two-forced colonoscope [18] comprises the disposable cartridge, which is putted on the distal end of the insertion part of endoscopic tube. The cartridge comprises invaginator and feeder. The feeder replaced an arm of endoscopist thus excluded the subjective moment of intubation. In this connection there are grounds to name the second two-forced endoscope as self-propelled.

The pneumo-mechanical intubation looks like the snake movement (see video). The process of intubation is controlled by the pedal of the feeder and by the guided distal end of colonoscope.

12. Basic sources of information

1. http://annals.org/article.aspx?articleid=743535 Screening for Colorectal Cancer: U.S. Preventive Services Task Force Recommendation Statement; Ann Intern Med., 2008.
2. http://www.mediasphera.ru/journals/practik/detail/39/240 Скрининг для выявления рака прямой и ободочной кишки. Международный журнал медицинской практики, 2009.
3. http://gastroenterology.jwatch.org/cgi/content/full/2012/914/3 More Postcolonoscopy Cancers Attributable to Colonoscopic Versus Polyp Factors; Douglas K. Rex, MD, 2012..
4. http://www.wjgnet.com/1007-9327/7/612.asp The impact of new technology on surgery for colorectal cancer, World Journal of Gastroenterology, 2001.
5. http://www.medscape.com/viewarticle/748898 Evolving Techniques in Colonoscopy, 2011
6. http://www.quality-in-endoscopy.org/assets/download/pdf/reports/qine20/02_1_thomas_gibson.pdf Tips and Tricks to Reach the Caecum: A Practical Guide; Siwan Thomas-Gibson, Quality in Endoscopy, Berlin, 4-5.05.2012.
7. http://annals.org/article.aspx?articleid=731108 Complications of colonoscopy in an integrated health care delivery system, Annals of Internal Medicine, 2006.
8. http://www.dntrofimov.ru/files/Filin_FKS/Aktualnyye_voprosy_podgotovki_patsiyenta_k_endoskopicheskomu_issledovaniyu_tolstoy_kishki.doc Актуальные вопросы подготовки пациента к эндоскопическому исследованию толстой кишки, Ленинградская областная клиническая больница, 2009.
9. http://www.eurekalert.org/pub_releases/2009-03/haog-gcp032309.php Germany: Colonoscopy prevents 15.000 cancer cases, 2009.
10. http://www.biomedcentral.com/1472-6920/13/5 Predictive factors affecting cecal intubation falure in colonoscopy trainees, BMC Medical Education, 2013.
11. http://forum.surgeryzone.net/viewtopic.php?f=58&p=237425 форум Surgeryzone, 2012.
12. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2657972 The difficult colonoscopy, 2007.
13. http://www.ncbi.nlm.nih.gov/pubmed/22187070 Adenoma Detection With Cap-Assisted Colonoscopy Versus Regular Colonoscopy, 2012
14. http://www.gastroendonews.com/ViewArticle.aspx?d_id=187&a_id=7878 Sedated Colonoscopy Can Increase Risk for Iatrogenic Perforation. Daniel M. Keller, 2005.
15. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC517648/ Quality improvement programme to achieve acceptable colonoscopy. completion rates: prospective before and after study; Jennifer E. Bail, 2004.
16. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3558566/ Advanced endoscopic technologies for colorectal cancer screening. World Journal of Gastroenterology, 2013.
17. http://worldwide.espacenet.com/publicationDetails/originalDocument?CC=SU&NR=1522466A1&KC=A1&FT=D&date=&DB=EPODOC&locale=en_EP Кишечный эндоскоп, С. Матасов, авторское свидетельство № 1522466, 1978.
18. http://worldwide.espacenet.com/publicationDetails/originalDocument;jsessionid=D18AD98DE785E6B61849B543B2F033C4.espacenet_levelx_prod_3?CC=EA&NR=002954B1&KC=B1&FT=D&ND=&date=20021226&DB=&locale=en_EP Эндоскоп с одноразовым патроном для инвагинации эндоскопической трубки. Патент № 002954 от 26.12.2002. Евразийское патентное ведомство.

13. Basic sources of information

19. http://worldwide.espacenet.com/publicationDetails/originalDocument?FT=D&date=20070502&DB=EPODOc&locale=en_EP&CC=EP&NR=1034010B1&KC=B1&ND=4 Endoscopic insertion aid. European patent EP1034010 from 02.05.2007.
20. http://worldwide.espacenet.com/publicationDetails/originalDocument?FT=D&date=200010120&DB=EPODOc&locale=en_EP&CC=LV&NR=12474B&KC=B&ND=4 Endoscope with single-use cartridge for invagination of endoscopic tube. Latvia patent 12474, 20.01.2001
21. http://worldwide.espacenet.com/publicationDetails/originalDocument?FT=D&date=20080116&DB=EPODOc&locale=en_EP&CC=CN&NR=100361619C&KC=C&ND=4 Endoscope with single-use cartridge for invagination of endoscopic tube. China patent 100361619, 16.01.2008
22. http://worldwide.espacenet.com/publicationDetails/originalDocument?FT=D&date=20070508&DB=EPODOc&locale=en_EP&CC=CA&NR=2304776C&KC=C&ND=4 Endoscope with single-use cartridge for invagination of endoscopic tube. Canada patent CA2304776, 08.05.2007
23. http://worldwide.espacenet.com/publicationDetails/originalDocument?FT=D&date=20040513&DB=EPODOc&locale=en_EP&CC=AU&NR=773032B2&KC=B2&ND=4 Endoscope with single-use cartridge for invagination of endoscopic tube. Australia patent AU773032, 13.05.2004
24. http://worldwide.espacenet.com/publicationDetails/biblio?DB=EPODOC&II=30&ND=3&at=18&locale=en_EP&FT=D&CC=IL&NR=135503A&KC=A Endoscope with single-use cartridge for invagination of endoscopic tube. Israel patent IL135503, 06.04.2000
25. Matasov S.A., Problems and prospects of intestinal intubation, www.coloncancer.lv/book.pdf , 2012