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Early and long-term results of antireflux surgery: a critical look

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A variety of operations have been described in the prevention of reflux by means of re-establishing or re-inforcing the gastro-oesophageal valve mechanism. However there has not been any conclusion as to which is the ideal procedure.

Reportedly the fundoplication, introduced by Nissen in 1956, is the most frequently used type of antireflux repair. At first the anterior *and* posterior fundic wall were united in front of the oesophagus; later on the technique was slightly changed (so-called Nissen–Rossetti modification), the latter being in common use nowadays. According to Rossetti, the anterior aspect of the fundus is brought posteriorly around the oesophagogastric junction and then is fixed to the anterior fundic wall (Figure 1).

Originally, Nissen intended to create only a mechanical antireflux valve (Nissen, 1956; Butterfield, 1971). Later, more subtle hypotheses were developed. Besides restoring the length of the intra-abdominal segment of the oesophagus narrowing the angle of His to prevent reflux (Blum and Siewert, 1981) seemed to be another important aspect of the Nissen operation (Jamieson, 1987).

Further investigation of the anatomical and mechanical conditions of the oesophagogastric junction revealed the 'myogen' activity of the fundic wrap, i.e. the ability of the cuff to react to humoral and nerve stimuli in the same way as the lower oesophageal sphincter (LOS) (Siewert et al, 1974). Thus, the fundic wall superimposes its contractile force upon the weakened LOS, as an ancillary mechanism of reflux impairment (Golenhofen et al, 1979), independent of whether it is located intra-abdominally or within the thorax. This theory is supported by common clinical experience. The Nissen fundoplication will also work reliably in the case of being slipped into the thorax (Bombeck et al, 1970; Mansour et al, 1981; Maher et al, 1985). On the whole this idea is widely accepted and most of the former, more mechanical models, are now obsolete.

One further idea has become increasingly popular over the last few years. According to Petterson et al (1980) the formation of a more or less circular ring around the cardia is sufficient to prevent reflux by neutralizing the

opening forces of gastric distension on the LOS, achieving the same result as total fundoplication. Intrathoracic displacement of the wrap (and cardia) or a very 'loose' or floppy construction should not interfere with the effectiveness of this method. Moreover, it explains the mode of action of procedures such as the Angelchik prosthesis (Angelchik et al, 1983; Ancona et al, 1986) or the Narbona 'sling' (Narbona, 1986), which although clinically proven were previously poorly understood. The fundoplication of Nissen elevates the LOS resting tone and even creates a slight amount of residual pressure during swallowing-induced relaxation, so that the occurrence of the so-called 'inappropriate relaxations' is reduced or totally abolished (Kiroff et al, 1984). Since it acts as a one-way valve, gastro-oesophageal reflux is suppressed completely. On the other hand, propulsive force disturbances of the tubular oesophagus and/or heavily reduced oesophageal clearance are aggravated by the creation of a very effective antireflux barrier. Therefore, patients with scleroderma or other disorders of impaired swallowing are bad subjects for a fundoplication.

The *Belsey mark IV* operation was first performed by Belsey in 1955. It can be performed only through a thoracic approach and consists of the plication of the stomach around approximately 270° of oesophageal circumference, leaving the posterior vagus nerve uncovered by the plication. A posterior segment of the oesophagus is not included in the wrap but instead is buttressed against the narrowed hiatus (Figure 2).

The *Hill procedure* (Figure 3) differs in technical details but incorporates the same principles as the aforementioned procedure. After extensive mobilization of the oesophagus through an abdominal incision, the hiatus is narrowed and the cardia is anchored to the arcuate ligament just above the coeliac axis. A further decisive step is to 'calibrate' the cardia with sutures to both the anterior and posterior wall of the subcardial gastric fundus to create a partial plication around the LOS. The internal diameter of the cardia remaining after this manoeuvre is critical and the use of an appropriate bougie is advocated. Basically it resembles the Nissen fundoplication. Most of the theories which have been developed to explain the well-documented antireflux effect of the Nissen technique or the Belsey procedure fit in well with the postulated mode of action of the Hill repair.

Several authors recommend a combined technique of gastroplasty, introduced first by Collis in 1961, as an operation to lengthen the oesophagus in patients with oesophageal shortening, together with a total (Nissen) fundoplication (Bingham, 1977; Henderson, 1977; Orringer, 1985).

Theoretically, the combined technique seems to have certain advantages: less problems in wrapping the fundus around the oesophageal tube (since this can always be carried out intra-abdominally); a better quality of tissue available; the lack of tension on the oesophagus; and possibly the use of the left gastric artery as a natural tether to the lower end of the gastroplasty tube. These advantages enable Henderson (Henderson and Marryat, 1983) to achieve a lower recurrence rate with the combined technique than with a comparable procedure. However, gastroplasty tends to be followed by fistula, which increases postoperative morbidity. Also in some cases gastroplasty may be very difficult to perform because of severe perioesophagitis. From a

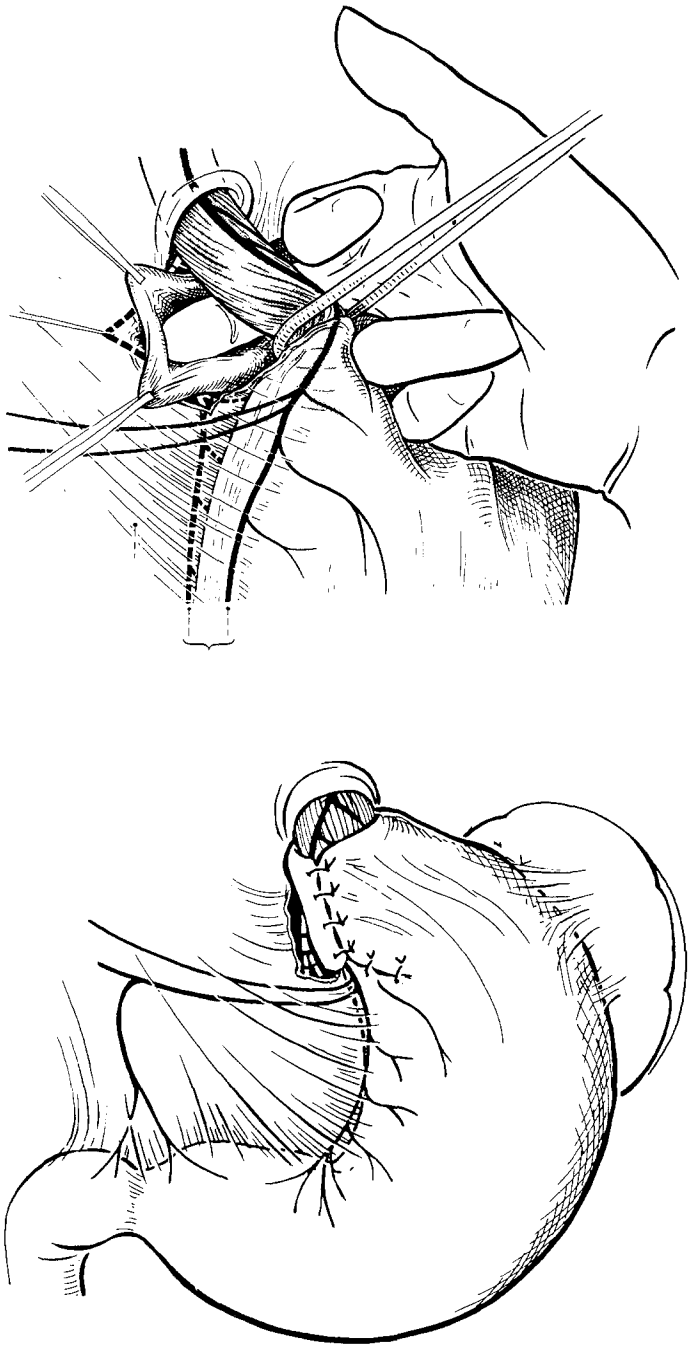

Figure 1. Nissen procedure. A fundic fold of the anterior gastric wall is brought posteriorly around the oesophago-gastric junction (a) and is fixed to a corresponding fold of the fundus (b).

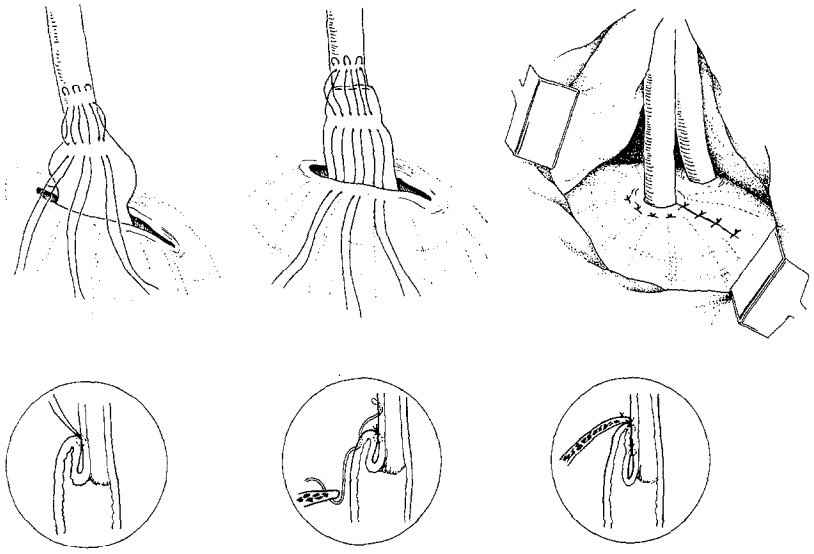

Figure 2. Belsey mark IV operation. By a transthoracic approach, three-quarters of the oesophageal circumference is covered by the wrap and the hiatus is closed.

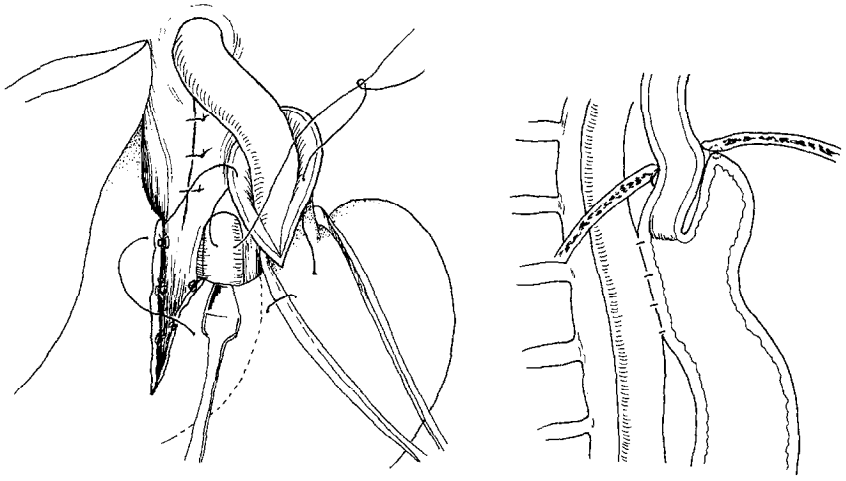

Figure 3. Hill's procedure. Narrowing of the hiatus and fixation of the cardia to the arcuate ligament and the pre-aortic membrane. Finally, the fundus is partially plicated around the cardia.

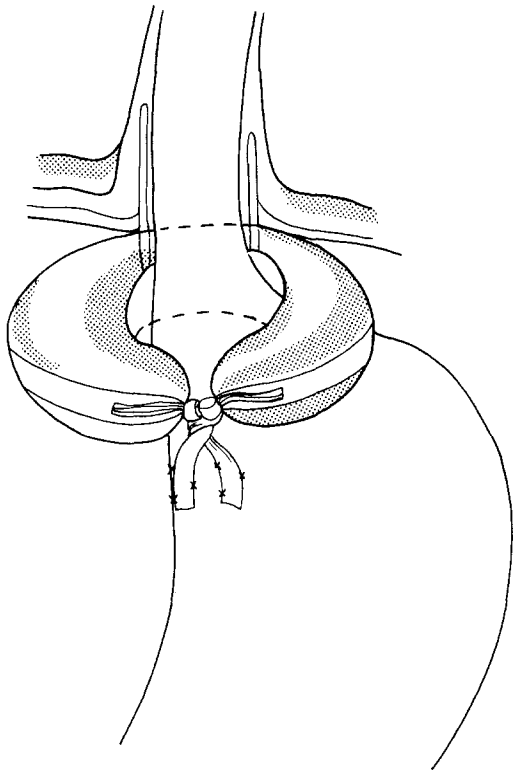

Figure 4. Angelchik antireflux prosthesis. The sausage-shaped device is placed around the gastro-oesophageal junction and the strings are knotted.

pathophysiological point of view, the Collis–Nissen technique creates an artificial columnar-lined oesophagus.

In addition to these well-established techniques, a further one deserves to be mentioned. Introduced by Angelchik in 1973, the Angelchik prosthesis is a sausage-shaped silicone device placed around the gastro-oesophageal junction (Figure 4). Although it is not easy to explain the cause of its effectiveness, the results obtained by this passive antireflux repair seem to be at least comparable to those obtained by the Nissen repair (Siewert et al, 1977; Watson et al, 1984; Gear et al, 1984).

For historical reasons only, the numerous approaches to an *anatomical repair of the hiatal hernia* should be mentioned. Since they were usually developed to correct anatomy rather than the functional outcome, reflux prevention is poor. This is true for the so-called hiatoplasties (Allison, Sweet, Welch, Harrington), gastropexies (Nissen, Boerema) and other miscellaneous procedures, which therefore have to be considered obsolete. A more recent report by DeLaet and Spitz (1983) of a group of 133 children indicated a failure rate to control reflux of 42% after the Boerema gastropexy compared

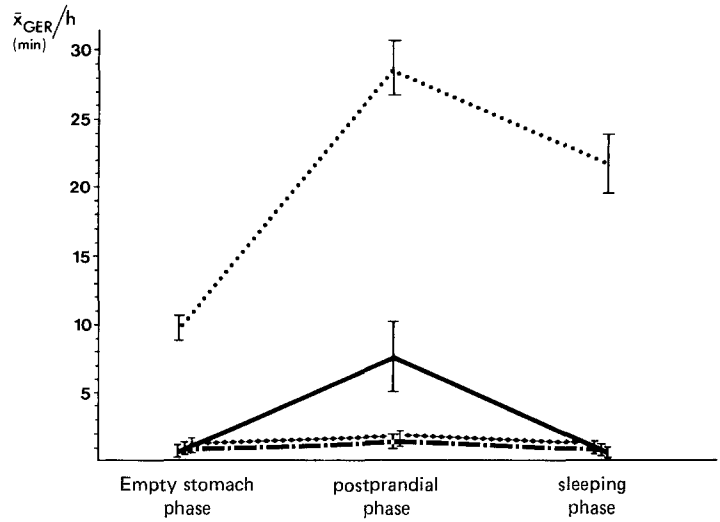

Figure 5. Gastro-oesophageal reflux under normal conditions, in reflux disease and after antireflux surgery (Blum and Siewert, 1981). Gastro-oesophageal reflux is completely suppressed both after fundoplication and use of the Angelchik device. $\bar{x}_{GER}$/h is the mean of the pH below 4 during one hour of examination. ——, controls; · · · · Pat., pathological gastro-oesophageal reflux (preoperative); — - — - —, fundoplication; ♦♦♦, silicone antireflux prosthesis.

with a 9.6% failure rate in the fundoplication group. From a functional point of view, all of the so-called 'definitive' antireflux procedures have one thing in common: they completely prevent any amount of gastro-oesophageal reflux (Figure 5). Under physiological conditions a certain extent of gastro-oesophageal reflux is quite normal, especially after meals. Therefore after an effective antireflux operation a mild degree of 'supercontinency' is inevitable as an intrinsic complication.

The more severe the reflux problems were before the operation, the more the patient is inclined to neglect the symptoms of supercontinency, such as gas-bloat or mild dysphagia. Nevertheless there is no doubt that the current techniques of operative reflux therapy must be refined (Fekete and Perniceni 1986).

POSTOPERATIVE SYNDROMES FOLLOWING ANTIREFLUX SURGERY (See Figure 6)

Before discussing the detailed results of antireflux surgery, it is important to discern clearly whether those symptoms relate directly to the type of operation or whether they are induced by technical failures. The latter should be avoidable.

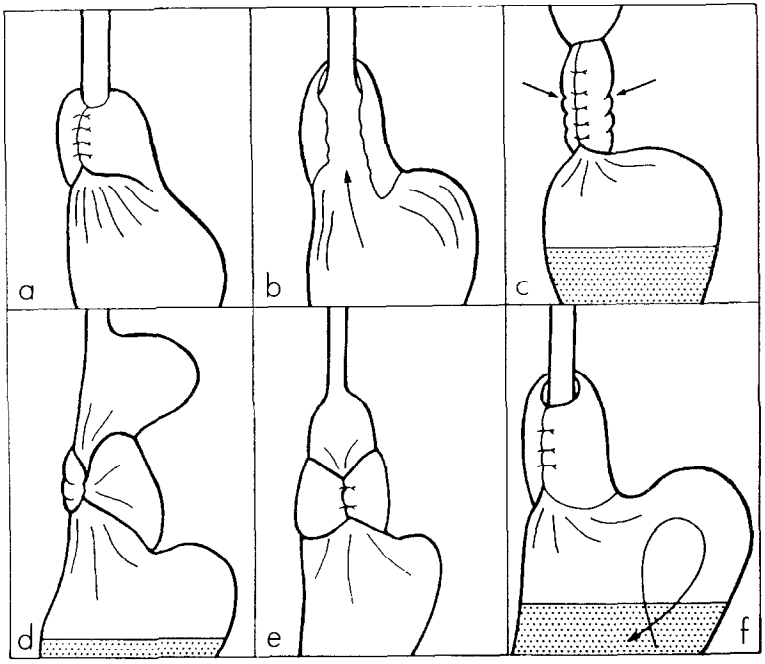

Figure 6. Typical postfundoplication syndromes: (a) normal; (b) cuff disruption; (c) tight cuff; (d) 'slipped Nissen' or telescope phenomenon; (e) improper initial location of the wrap around the stomach; (f) gas-bloat (broad cuff gastric denervation).

Inborne shortcomings of antireflux procedures

Effective antireflux surgery automatically implements the development of a more or less marked supercontinency after the operation. If, after the operation, the patient is not able to reduce his usual habit of swallowing air (so-called upright refluxer), to which he is accustomed in order to alleviate his reflux symptoms, it will lead to gas-trapping in the fundic part of the stomach. The air, however, cannot be released as easily as before, since the gastro-oesophageal valve is now sufficient. Thus, many patients may complain about symptoms such as gas-bloat, meteorism and the inability to belch (Hirsig 1984) (Figure 6f). Most of the patients, however, become accustomed to the situation and their symptoms eventually disappear. The more severe the reflux disease prior to surgery, the more inclined the patients are to tolerate slight side-effects.

According to various reports, the symptoms of dysphagia may occur in 10–70% of cases immediately after the operation. However, dysphagia will cease spontaneously in the course of the next 3–4 months (Payne, 1984). It is possibly due to an impaired migration of the cardia during the act of swallowing, or the consequence of a disturbed oesophageal motility after the intraoperative mobilization of the distal part of the oesophagus (Siewert and

Weiser, 1984). Inhibition of the swallowing-induced relaxation by the cuff may also be a cause.

The intrathoracic displacement of the wrap, as long as it is still positioned around the LOS, should not be automatically considered a technical failure, since the valve function can be maintained (Figure 2b). However, typical complications more frequently to be expected are congestion gastritis, herniation, ulcer formation and dysphagia (Mansour et al, 1981).

Technically induced failures of the Nissen operation

The majority of complications following fundoplication are due to surgical failure. The frequency is inversely dependent upon experience and surgical skill.

Opening of the cuff

Partial or complete opening of the cuff, often associated with recurrent reflux disease, is due to the breakdown of the stitches that unite the anterior and posterior fold of the fundic plication in the anterior oesophageal midline. Besides avoiding any tension on the wrap, careful sewing technique and the use of non-absorbable sutures are advocated to avoid this complication, which is the common cause of recurrent gastro-oesophageal reflux. A correct diagnosis is often difficult, since the typical radiological manifestation as described by Hatfield (Hatfield and Shapier, 1985) and Saik (Saik et al, 1977) is seldom found. Oesophageal manometry will clarify the situation (Figure 6b).

The inability to demonstrate a cuff by X-ray or by endoscopy (inversion!) must give the suspicion of an opened cuff.

'Slipped Nissen'

The slipped Nissen or the 'telescope phenomenon', as it is called in German literature (Siewert et al, 1977), occurs when the distal oesophagus and adjacent fundus 'slip' through an intact wrap. Usually this is caused by omission or the breakdown of the sutures that incorporate the oesophageal muscular wall in the wrap. The slippage may also lead to traction of the greater curvature of the stomach and to the formation of a fundal pouch, which is represented by the radiographical 'hour-glass' phenomenon of the stomach (Figure 6d). This results not only in recurrent reflux but also in severe dysphagia. Surgical re-intervention is inevitable. The main cause of this complication is the excessive mobilization and dissection of the lesser curvature. However it must be suspected that in some cases the fundus has already been wrapped around the stomach instead of the oesophagus during the primary operation, thus only mimicking a slippage.

Tight wrap

One of the basic techniques of modern antireflux surgery is the creation of a 'floppy' cuff, since this sufficiently prevents gastro-oesophageal reflux. A

narrow wrap will not yield additional antireflux effectiveness, but gives rise to severe dysphagia. It is possible to try to dilate a cuff that is too tight. However, this may be either ineffective (Feussner et al, 1987) or may lead to disruption of the cuff (Figure 6c).

Gastric denervation syndrome

Vansant and Baker (1976) found a much higher rate of postoperative symptoms when vagotomy was added to the antireflux procedure, thus supporting the importance of preserving the innervation of the stomach. Supposedly, lesions of the vagal nerves or their minor branches happen more frequently during the dissection of the cardia and lesser curvature than originally described. Postoperatively, dilatation of the stomach, impaired gastric empyting, diarrhoea, gas-bloat (Figure 6f) and meteorism are the consequence and may be very difficult to treat. The syndrome can be avoided by cautious dissection of the critical area.

Post-Angelchik syndromes

Obviously, the Angelchik silicone prosthesis is also effective in preventing oesophageal reflux. After 10 years of experience one can carefully evaluate its clinical use and its side-effects. The main drawback is its tendency to dislocate alongside the gut axis either intrathoracically (Condon, 1983; Pickleman, 1983; Burke et al, 1985) or aborally around the stomach. The latter may be the predecessor of a perforation into the stomach, which has been reported in at least 0.2% of cases (Lackey and Potts, 1982; Benjamin et al, 1984; Durrans et al, 1985) (Figure 7a–c). In a few cases, rotation of the device from the horizontal to the vertical plane has been reported, followed by severe dysphagia (Figure 7f). This can easily be detected by a single X-ray of the thorax. However the phenomenon of the 'tilting' Angelchik may be very difficult to discover. As demonstrated in one of our own cases, during swallowing, the prosthesis regularly turns around the axis of the knot, thus inducing epigastric pain, especially during food intake (Figure 7e).

Under resting conditions the device is properly located, making it very difficult to diagnose the cause of dysphagia. Normal barium roentgenograms do not reveal this malfunction since the movement is too rapid. High-speed cinematography is therefore required to diagnose the tilting Angelchik.

A few cases of breakdown of the central knot are well documented (Peloso, 1982) (Figure 7d). This complication becomes less frequent after technical improvements of the device. Nevertheless the specific problems of the foreign body around the gastro-oesophageal junction will remain, causing further problems with this otherwise interesting device.

REOPERATION FOR FAILED ANTIREFLUX REPAIR

What should be done for those patients who, postoperatively, again develop symptoms of reflux or dysphagia or both? In general, a relapse of reflux should

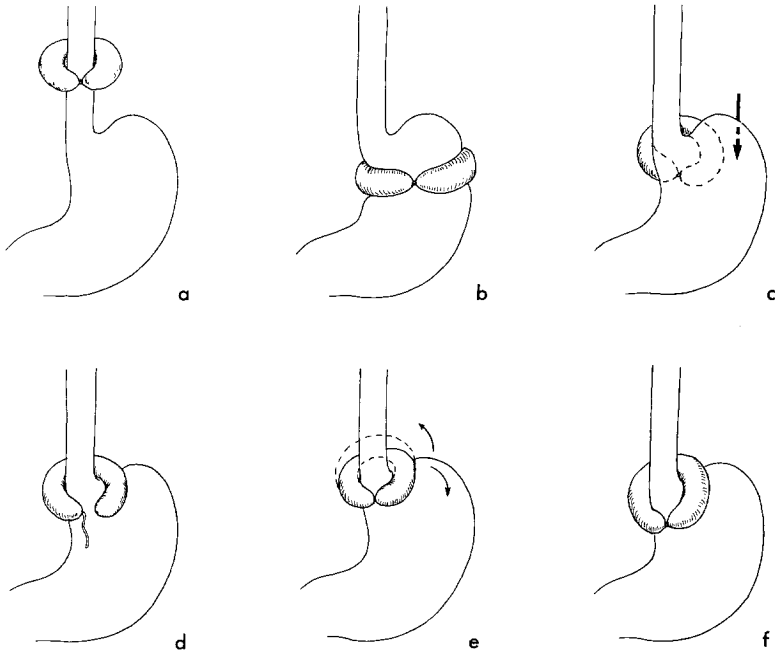

Figure 7. Post-Angelchik syndromes: (a) oral migration; (b) aboral migration; (c) perforation into the stomach; (d) breakdown; (e) tilting; (f) vertical displacement.

be treated (again) by H_2-blockers. If conservative treatment is not able to relieve the complaints, a surgical reintervention is indicated. The question of re-operation for failed antireflux surgery is becoming a speciality of its own. The results, however, are hard to interpret, as most of the authors use a variety of different procedures depending upon the type of initial operation and the problems arising postoperatively (Table 1). In the case of recurrent reflux, the re-operation usually is not too difficult, since the cuff is either partially or completely opened. Many more problems are to be expected in patients who develop dysphagia or both dysphagia and reflux following a previous antireflux procedure. As a rule, dysphagia is a result of a stricture/stenosis within the area of the gastro-oesophageal junction or aborally of it, which in most cases is caused by a cuff being located wrongly, or slipped down. This leads to an extraluminal narrowing by the cuff or scars. From a technical point of view, this makes a reintervention difficult and more risky for the patient.

Before attempting to re-operate an exact analysis of the type of complication is of utmost importance, including a careful history, radiographical studies, endoscopy and manometry (Figure 8). In all instances of primary motility disorder, a completely different strategy is obligatory. We advise in cases involving scleroderma, the Roux operation or a myotomy, and the Thal fundoplasty for the achalasia of the oesophagus (Siewert and Feussner, 1988).

Table 1. Re-operation for failed antireflux surgery.

Reference	No. of patients	Previous operation	Re-operation
Hill et al (1979)	23	23 Fundoplications	24 Hill procedures 1 Jejunal interposition
Leonardi and Ellis (1983)	38	38 Fundoplications	1 Hill 12 Total oesophagectomies 21 Fundoplications 4 Collis–Belsey 2 Collis–Nissen 8 Others
Hatton et al (1984)	11	11 Fundoplications	4 Resections 5 Re-fundoplications (up to 4 reoperations)
Salo et al (1985)	6	6 Fundoplications	6 Roux-en-y reconstruction/ partial gastrectomies
Maher et al (1986)	56	30 Fundoplications 9 Gastropexies 10 Belsey mark IV 8 Crural repairs	11 Posterior gastropexies 44 Fundoplications
Ancona et al (1986)	24	7 Fundoplications 4 Belsey mark IV 4 Lortat–Jacob 2 Angelchik 7 Partial fundoplications	10 Oesophagectomies 7 Duodenal diversions 2 Nissen 4 Partial fundoplications
Own results (1987)	66	45 Fundoplications 21 Gastropexies 2 Angelchik	59 Refundoplications 9 Miscellaneous

Under 'normal' circumstances one should again consider a fundoplication, whether or not the Nissen procedure was initially used (Leonardi and Ellis, 1983; DeMeester et al, 1986; Bancewicz et al, 1987; Feussner et al, 1987). The rate of intraoperative complications and postoperative morbidity is, of course, higher than in the primary operation, but this is also true for all types of secondary antireflux operation. Refundoplication, however, seems to yield the same satisfactory functional results as after primary application. This is supported by our own experience of 59 re-operations after different previous procedures (Bancewicz et al, 1987; Feussner et al, 1987).

CLINICAL RESULTS FOLLOWING ANTIREFLUX SURGERY

Early results

Intraoperative complications and in-hospital lethality are low. This is true for almost any type of antireflux procedure and is independent of whether it is performed by laparotomy or thoracotomy.

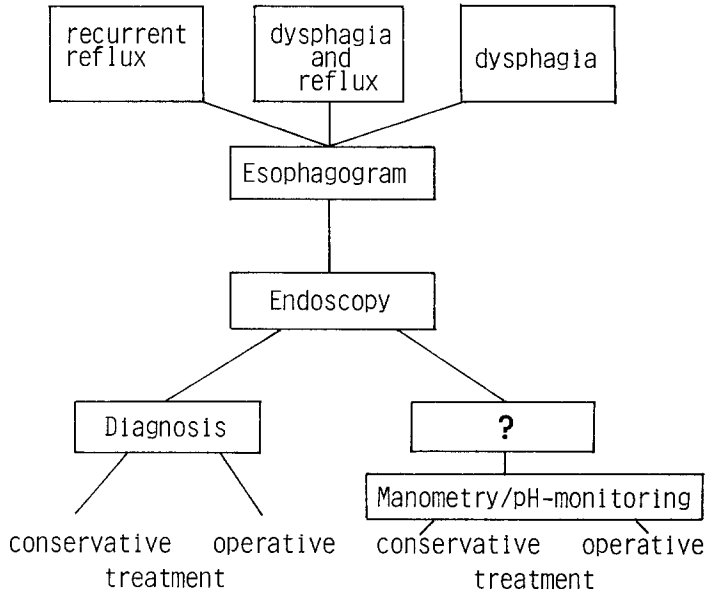

Figure 8. Evaluation of postoperative syndromes after antireflux surgery.

Table 2. Post-operative complications after reflux procedures.

Reference	Year	No. of patients	Mortality %	Wound infection %	Pulmonary complications %	Splenic lesions %	Others %
Fundoplication							
Ellis and Crozier	1984	92	0	4.4	—	—	4.4
Donahue et al	1985	77	1.4	4.0	—	4.0	—
O'Rourke	1985	105	0	2.9	4.8	0	0
DeMeester et al	1986	100	1.0	1.0	5.0	1.0	5.0
Shirazi	1987	350	0	4.0	6.0	8.5	1.6
Gouillat	1987	81	0	—	6.2	7.4	3.7
Siewert	1987	45	0	4.4	4.4	2.2	—
		850	0–1%	1–4%	4–6%	1–8%	

Today, mortality should be around zero (Table 2). Usually the cause of a fatal outcome is not directly related to the particular procedure but instead is due to general surgical risk (thrombosis, cardiovascular diseases etc.). Of major vital importance is the occurrence of a gastric/oesophageal perforation when stitches are tied too narrowly or the presence of intramural lesions. Fortunately these situations are rare and are generally confined to re-operations.

Pulmonary complications consist of pleural effusions and/or pneumonic infiltrates; their frequency is comparatively high (about 5%) even after an abdominal approach. Time of hospitalization is prolonged by intercurrent wound infections, but the incidence is comparable to other abdominal procedures. Splenic lesions should be mentioned since splenectomy is required in 1–4% of cases after a Nissen procedure, whereas it is seldom necessary during a Belsey Mark IV operation. On the whole, splenectomy is not a harmless side-effect of the operation. The removal of the spleen as a consequence of an intraoperative lesion may lead to several postoperative complications like wound infection, subphrenic abscess or pancreatic fistulae (Rogers et al, 1980; Postlewaith, 1986).

Generally, an overall incidence of postoperative complications of 11% has to be assumed (1977). Complications range from urinary tract infections or bowel obstructions to the more specific sequelae described above. Subjective complaints, however, will occur much more often within the early postoperative period, but this will significantly improve after the first 6–12 weeks. Dysphagia is the most common symptom after any antireflux procedure, especially after the Nissen fundoplication (Skinner, 1977).

According to Negre's study, all patients suffered from transient dysphagia (Negre, 1983) which lasted from a few days to one year, whereas in the DeMeester and Johnson study (De Meester et al, 1974) 86% of patients experienced dysphagia, which improved within 6 months. It has to be kept in mind, however, that these reports concern patients who had been operated on at a time when the significant value of a floppy fundoplication was still unknown. It seems likely that in many cases too tight a wrap was executed. According to more recent publications, the rate of immediate postoperative dysphagia is significantly lower. For example, after the floppy fundoplication, the disappearance of the dysphagia gradually over a four-to-six week period is supported by further studies (Postlewaith, 1986; Feussner et al, 1987). According to our own experience, postoperative dysphagia is rare when a loose fundoplication is performed. DeMeester indicated convincingly two decisive factors as being responsible for the improvement: firstly, an increased calibre of bougie used to size the gastric wrap; and secondly, a reduced length of gastric wrap to approximately 2–3 cm (Figure 9). Thus, temporary discomfort on swallowing could be decreased from 50% to 39% (DeMeester et al, 1986). A further most important factor is the generous mobilization of the fundus, since only after these circumstances is it possible to create a floppy fundoplication. On the whole, it should be pointed out that nowadays postoperative (temporary) dysphagia is harmless in most cases and it is only necessary to inform the patient about this potential discomfort before the operation is performed.

Postoperative gas-bloat can be thought of as a souvenir of the reflux disease after a successful operation. Its incidence and persistency depends upon the patient's adaptation to reflux prevention. The more successful he is at giving up swallowing air the quicker the gas-bloat syndromes will disappear. Immediate relief from reflux symptoms is the most impressive result following antireflux surgery.

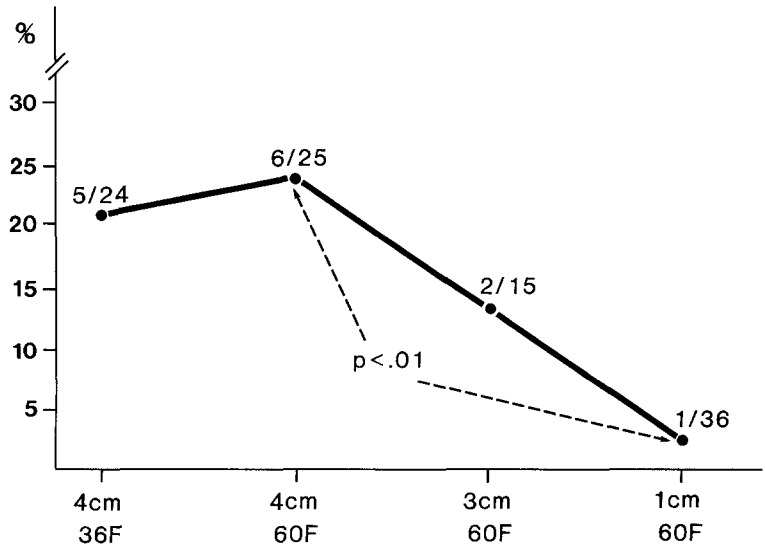

Figure 9. Incidence of induced persistent dysphagia in relation to the technique used to construct the fundoplication ($n = 100$). A significant reduction occurred by reducing the length of the gastric wrap to 1.0 cm [according to DeMeester et al (1974)].

Long-term results

After the first 30 years of application a lot of retrospective follow-ups and only some prospective studies are available to evaluate the clinical value of the Nissen procedure. However, it must be taken into consideration that, originally, most of these antireflux operations were performed with the purpose of hiatal hernia repair (Boesby et al, 1982). This changed slowly only during the last few years and makes it difficult to evaluate data of early collectives.

According to DeMeester's group of 100 consecutive patients, the Nissen operation prevents reflux successfully in 91% of patients over a 10-year period (DeMeester et al, 1986). This is supported by many similar studies (Postlewaith, 1986), making it realistic to assume a recurrence rate of reflux of about 10% after 10 years following fundoplication. Obviously, late relapses are possible even after more than a decade, whereas the frequency of dysphagia, frequently found immediately after the operation, continuously decreases during the first five years after the operation. This fact was first described in the publication of Brand et al (1979).

Second to recurrence of reflux, dysphagia and gas-bloat are important postoperative complications. Their clinical importance and frequency differ widely (from 1.3% to 30%) (Table 3) but analysing the data supports at least two conclusions: first there is a clear trend toward improvement of dysphagia after extended follow-up, in contrast to reflux recurrence (Figure 10); second, most authors have changed or modified the procedure towards creating a very loose fundoplication in the last few years (Ellis and Crozier, 1984; Gourge,

Table 3. Late results after fundoplication.

Reference	No. of patients	Length of follow-up (months)	Relapse of reflux %	Gas-bloat %	Dysphagia %	Gastric ulcer %	Dumping %	Visick I–II	Visick III–IV
Negre (1983)	60	120	19	30	—	—	5	85	15
Donahue et al (1985)	62	49	2.6	1.3	—	—	—	unknown	—
O'Rourke (1985)	37	24 (6–60)	—	18.9	—	—			
DeMeester et al (1986)	100	45 (12–156)	3	11	14	—	2.7	75.7	24.3
Ackermann et al (1987)	290	120	13.1	—	11.3	8.3	4.8	70.5	29.5
Gourge (1987)	40	24–48	7.5	5	—	—	—	—	—

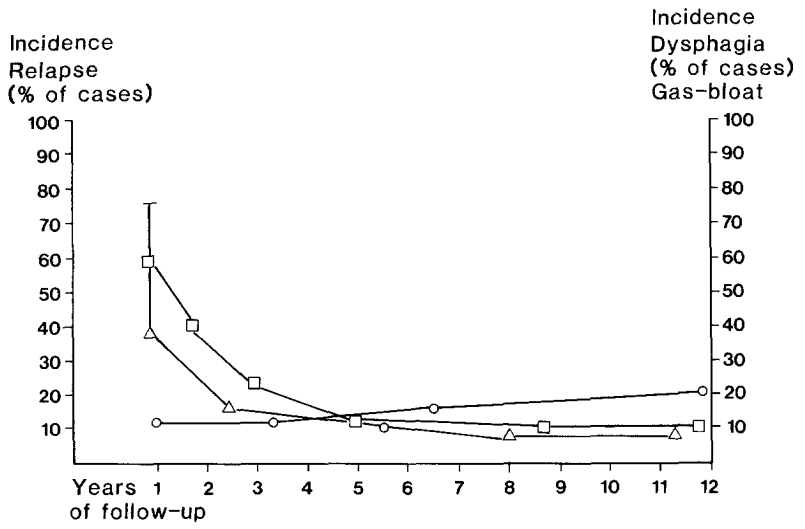

Figure 10. Postoperative course after antireflux surgery. The incidence of dysphagia (□) decreases, whereas relapse of reflux (○) shows a tendency to become more frequent in the long-run. Complaints about additional side-effects (△) remain unchanged.

1987; DeMeester et al, 1986). This induced a dramatic decrease of these side-effects, though the rate of relapses remained stable. Postoperative dumping has been mentioned by some authors (Ackermann et al, 1986) but it is usually only of minor importance and should be treated conservatively. The incidence of gastric ulcer formation seems to be high, but it is difficult to decide without matched controls whether they result from the fundoplication or just occur in the normal course of life.

With regard to alternative procedures, it is difficult to find figures of long-term results. On the basis of five different papers from 1971 to 1979, which included 2000 patients, it can be estimated that gastro-oesophageal reflux can be treated successfully in about 85% of cases (range 80–92%).

In a recent report, however, more favourable results were shown which were the result of, according to the author (Lernt et al, 1986), better patient selection and particularly careful application. Excellent results are also reported with various other techniques, such as the Hill procedure, cardiopexy with the round ligament and even after anatomical repair, but they still have to be confirmed by broader experience. Despite these impressive results, it must be understood that 5–10% of patients have to undergo reoperation after any type of antireflux procedure. This figure must be considered far too high in cases of benign disease.

Intensive work is required to improve the outcome, which may be achieved by more closely observing a few basic principles which can be outlined as follows:

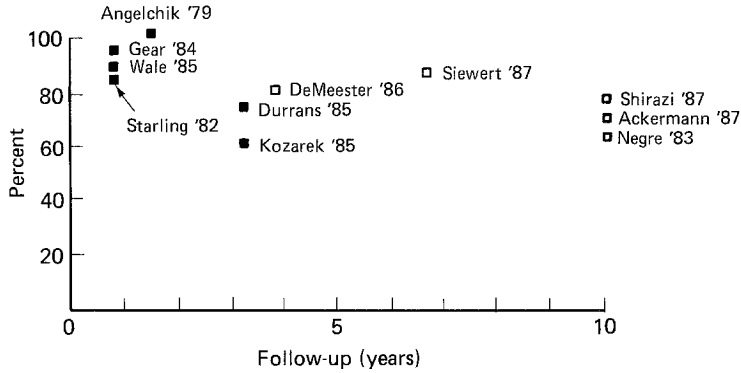

Figure 11. Clinical results (Visick I/II) following fundoplication and the Angelchik prosthesis. Despite favourable short-term results of the prosthesis, there is a clear tendency of deterioration after 4 years of follow up. □, fundoplication; ■, Angelchick prosthesis.

1. *Better selection of patients*

This includes a careful manometric examination of the LOS and the oesophageal body in order to rule out patients with motility disorders of a type other than reflux-induced disturbances of normal propulsion. Patients with collagen disorders or achalasia, for example, should not be candidates for a Nissen procedure, since a well-maintained propulsive force of the oesophagus is a premise of fundoplication. Otherwise, dysphagia is clearly predictable and will worsen in the course of time.

Oesophageal manometry must be complemented by long-term pH-monitoring in order to evaluate the extent of gastro-oesophageal reflux, particularly in those cases with severe complaints but only slight or absent morphological lesions of the oesophageal mucosa. Gastro-oesophageal reflux during sleep is always an index of severe gastro-oesophageal reflux disease, whereas reflux in the upright position may still be physiological.

2. *Selection through preoperative medical treatment*

Severe endoscopic findings, i.e. reflux oesophagitis or complications of it, and/or the respective results of long-term pH-monitoring and manometry are generally accepted as a recommendation for surgical treatment. This opinion, however, has to be revised thoroughly. There is only one clear indication for surgery today: if the patient does not become free of symptoms after an interval of at least 8–12 weeks of intensive medical therapy, or if he gets a recurrence with long-term therapy with H_2-blockers. In other words: patients should not undergo operation without an adequate preoperative conservative treatment.

Although the endoscopic diagnosis of a severe reflux oesophagitis is of high predictive value in determining whether an antireflux procedure will be necessary, it is nevertheless important to attempt medical treatment initially.

A small percentage of patients will be cured (about 10–30%) making an operation unnecessary.

On the other hand, those who do not benefit from medical therapy will be more apt to accept minor side-effects after surgical treatment.

3. *Improved surgical technique*

Today, a higher therapeutic effectiveness of antireflux procedures is demanded than in the pre-H_2-blocker period. Concurrently the frequency of operation decreases. This situation can only be met by concentrating the smaller number of patients on particularly experienced and specialized clinical units. This is because successful surgical therapy in these cases is not only based upon the personal skill of the surgeon but also upon the diagnostic facilities, including endoscopy, manometry, and pH-monitoring. The second premise is to use only well-established procedures which reliably prevent reflux without causing too many side-effects. At present, this is undoubtedly best met by Nissen's fundoplication. A few technical suggestions are provided below.

First of all, the cuff has to be established in a very 'floppy' manner, in order to avoid the narrowing of the oesophagocardial junction. The use of a bougie with an adequate calibre (40F), and an extensive mobilization of the fundus by dissection of the short gastric veins are decisive prerequisites.

Furthermore, according to clinical experience, it seems to be crucial that the cuff is not created too broadly. Obviously it is quite sufficient to establish a loose plication over a length of only 2–3 cm (DeMeester et al, 1986).

Theoretically, all these requirements seem to be realized in an almost ideal way by the silicone prosthesis. Yet it may not be advocated because of its potential risks as a foreign body, as mentioned above and clinical experience actually seems to indicate a deterioration in the long run (Figure 11). It may be that the problems caused by the 'foreign body' can be solved in the future by changing the material of the prosthesis.

FURTHER DEVELOPMENT OF ANTIREFLUX SURGERY – PROSPECTS AND PROBLEMS

The lesson taught by clinical experience and careful analysis of numerous publications is twofold; an optimal antireflux effect is achieved by (a) using a smaller cuff or sling rather than one that is too broad positioned exactly at the level of the LOS, and (b) by a loose circumferential fixation.

As the successful use of the passive silicone cuff obviously demonstrates, it is not necessary to enhance the sphincter strength by an additional muscular layer (which seemed to be realized by the fundic cuff of the Nissen procedure). Instead it is more important to create a ring exactly around the cardia which 'buttresses' the LOS.

Petterson and Bombeck proposed, on the basis of experimental studies, a most elegant explanation of this hypothesis with their idea of the neutralization of the intragastral opening force exerted on the LOS (Petterson et al,

1980). This theory is not only consistent with the Angelchik device but also with some very interesting, more recent techniques such as the one proposed by Narbona with his 'sling approach' or cardiopexy with the round ligament and similar models (Boutelier and Jonsell, 1982; Narbona, 1986). Yet it is too early to argue for one of these methods and a Nissen procedure, carried out properly, is still preferable.

Having a successful surgical method available is only one aspect in deciding whether to operate or to treat conservatively. To some extent the clinical situation concerning reflux therapy is comparable to that of ulcer disease: coincidentally, with a marked improvement of the surgical strategy, the clinical impact of a revolutionary new agent drastically reduces the number of patients who really need an operation. However, there seems to be a slight but meaningful difference between ulcer therapy and reflux disease. Whereas long-term prophylaxis of duodenal ulcers seems to be effective, it is obviously not the case in reflux therapy. Though comparatively little is known about the natural course of the disease in the long-run, it has already been shown that even short-term relapse cannot be avoided by standard doses of H_2-blockers. Johansson and Tibbling (1986) indicate clearly in their study of 31 patients the long-term superiority of fundoplication over prolonged medical treatment with ranitidine. Further experience is required, but surgical 'definitive' antireflux procedures seem to be superior in the long-run in treating recurrent reflux disease.

REFERENCES

Ackermann CH, Margreth L & Müller C (1987) Symptoms ten to twenty years after fundoplication. In Siewert JR, Hölscher AH (eds) *Diseases of the Esophagus*, pp. 1198–1202. Springer: Berlin.

Ancona E, Zaninotto G, Costantini M et al 1986) Reoperations after complications of failure of antireflux surgery. In Siewert JR, Hölscher AH (eds) *Diseases of the Esophagus*, pp. 1251–1254. Springer: Berlin.

Angelchik JP, Cohen R & Kravetz RE (1983) A ten year appraisal of the anti-reflux prosthesis. *American Journal of Gastroenterology* **78:** 671.

Bancewicz J, Mughal M. & Marpler M (1987) The lower esophageal sphincter after floppy Nissen fundoplication. *British Journal of Surgery* **74:** 162–164.

Benjamin SB, Kerr R, Cohen D, Motaparthy U & Castell DO (1984) Complications of the Angelchik antireflux prosthesis. *Annals of Internal Medicine* **100:** 570–575.

Bingham JA (1977) Hiatus hernia repair combined with the construction of an antireflux valve in the stomach. *British Journal of Surgery* **64:** 460.

Blum AL & Siewert JR (1981) *Refluxtherapie*. New York: Springer Verlag.

Boesby S, Sorensen HR, Mandsen T & Wallin L (1982) Failures after surgical treatment of patients with hiatus hernia and reflux symptoms. *Scandinavian Journal of Gastroenterology* **17:** 219–224.

Bombeck CT, Coelho RGP & Nyhus CM (1970) Prevention of gastroesophageal reflux after resection of the lower esophagus. *Surgery, Gynecology and Obstetrics* **130:** 1035–1043.

Boutelier P & Jonsell G (1982) An alternative fundoplicative maneuver for gastroesophageal reflux. *American Journal of Surgery* **143:** 260–264.

Brand DL, Eastwood IR, Martin D, Carter WB & Pope CE (1979) Esophageal symptoms, manometry, and histology before and after antireflux surgery. *Gastroenterology* **76:** 1393–1401.

Brenner GG (1977) Hiatal hernia – manometric and symptomatic assessment of failed surgical management in 60 patients. *South African Medical Journal* **51:** 25.

Burke PM, Chwals WJ & Ellis FH (1985) Complications after use of the Angelchik antireflux prosthesis. *Archives of Surgery* **120:** 498–500.

Butterfield W (1971) Current hiatal hernia repairs: similarities, mechanisms and extended indications. An autopsy study. *Surgery* **69:** 910.

Condon RE (1983) More misadventures with the esophageal collar. *Surgery* **93:** 477–478.

Csendes A, Braghetto I & Velasco N (1985) A comparison of three surgical techniques for the treatment of reflux esophagitis: a prospective study. In DeMeester TR & Skinner DB (eds) *Esophageal Disorders: Pathophysiology and Therapy*, pp 177–181. New York: Raven Press.

Deitel M, Basi SS & Ilves R (1985) The Angelchik antireflux prosthesis. *Canadian Journal of Surgery* **28(2):** 176–179.

DeLaet M & Spitz L (1983) A comparison of Nissen fundoplication and Boerema gastropexy in the surgical treatment of gastro-esophageal reflux in children. *British Journal of Surgery* **70:** 125–127.

DeMeester TR, Johnson LF & Kent AH (1974) Evaluation of current operations for the prevention of gastroesophageal reflux. *Annals of Surgery* **180:** 511–522.

DeMeester TR, Bonavina L & Albertucci M (1986) Nissen fundoplication for gastroesophageal reflux disease: evaluation of primary repair in 100 consecutive patients. *Annals of Surgery* **204(1):** 9–20.

Demos NJ (1984) Stapled, uncut gastroplasty for hiatal hernia: 12-year follow-up. *Annals of Thoracic Surgery* **38(4):** 393–399.

Donahue PE, Samelson S, Nyhus LM & Bombeck CT (1985) The floppy Nissen fundoplication: effective long-term control of pathologic reflux. *Archives of Surgery* **120:** 663–668.

Durrans D, Armstrong CP & Taylor TU (1985) The Angelchick anti-reflux prosthesis – some reservations. *British Journal of Surgery* **72:** 525–527.

Ellis HF & Crozier RE (1984) Reflux control by fundoplication: a clinical and manometric assessment of the Nissen operation. *Annals of Thoracic Surgery* **38(4):** 387–392.

Fekete F & Perniceni T (1986) Severe peptic esophagitis: classification and treatment. In Siewert JR, Holscher AH (eds) *Diseases of the Esophagus*, pp. 1163–1165. Springer: Berlin.

Festen C (1981) Paraesophageal hernia: a major complication of Nissen's fundoplication. *Journal of Pediatric Surgery* **16 (4):** 496–499.

Feussner H, Weiser HF & Siewert JR (1987) Sind die Ergebnisse nach Refundoplicatio schlechter als nach primärer Fundoplicatio? *Langenbecks Archiv für Chirurgie* (supplement) 1987.

Gear MWL, Gillison EN & Dowling BL (1984) Randomized prospective trial of the Angelchik antireflux prosthesis. *British Journal of Surgery* **11:** 681–683.

Golenhofen K, Weiser HF & Siewert JR (1979) Phasic and tonic types of smooth muscle activity in the lower esophageal sphincter and stomach of the dog. *Acta Hepatogastroenterology* **26:** 227–234.

Gouge TH (1987) The complete, loose fundoplication: results of operation for severe reflux esophagitis 1975–1985. In Stewert JR, Holscher AH (eds) *Diseases of the Esophagus*, pp. 1226–1229.

Gregoric HB & Cathcart R (1984) Surgical treatment of intractable esophagitis. *Annals of Surgery* **199:** 580–589.

Hatfield M & Shapier J (1985) The radiologic manifestations of failed antireflux operations. *American Journal of Radiology* **144:** 1209–1214.

Hatton PD, Selinkoff PM & Harford Jr FJ (1984) Surgical management of the failed Nissen fundoplication. *American Journal of Surgery* **148:** 760–763.

Henderson RD (1977) Reflux control following gastroplasty. *Annals of Thoracic Surgery* **24:** 206.

Henderson RD (1984) Dysphagia complicating hiatal hernia repair. *Journal of Thoracic and Cardiovascular Surgery* **88:** 922–928.

Henderson RD & Marryatt G (1983) Total fundoplication gastroplasty: long-term follow-up in 500 patients. *Journal of Thoracic and Cardiovascular Surgery* **85:** 81–87.

Herrington Jr JL, Meacham PW & Hunter RM (1982) Gastric ulceration after fundic wrapping: vagal nerve entrapment, a possible causative factor. *Annals of Surgery* **195:** 574–581.

Hill LD, Ilves R, Stevenson JK & Pearson JM (1979) Reoperation for disruption and recurrence after Nissen fundoplication. *Archives of Surgery* **114:** 542–548.

Hirsig J, Baals H, Tuchscmid P, Spitz L & Stauffer UG (1984) Dumping syndrome following Nissen's fundoplication: a cause for refusal to feed. *Journal of Pediatric Surgery* **19(2):** 155–157.

Jamieson GG (1987) Anti-reflux operations: how do they work? *British Journal of Surgery* **74:** 155–156.

Johansson KE & Tibbling L (1986) Maintenance treatment with ranitidine compared with fundoplication in gastroesophageal reflux disease. *Scandinavian Journal of Gastroenterology* **21:** 779–788.

Jonsell G (1983) The incidence of sliding hiatal hernias in patients with gastroesophageal reflux requiring operation. *Acta Chirurgiae Scandinavica* **149:** 63–67.

Kiroff GK, Maddern GJ & Jamieson GG (1984) A study of factors responsible for the efficacy of fundoplication in the treatment of gastro-oesohageal reflux. *Australian and New Zealand Journal of Surgery* **54:** 109–112.

Kjellén G, Fransson SG, Johansson KE et al (1984) Scintigraphy, radiography and acid clearing in dysphagia patients after anti-reflux surgery. *Scandinavian Journal of Gastroenterology* **19:** 1022–1026.

Koelz HR, Birchler R, Bretholz A et al (1986) Healing and relapse of reflux esophagitis during treatment with ranitidine. *Gastroenterology* **91:** 1198–1205.

Kozarek RA, Brayko CM, Sanowski RA et al (1985) Evaluation of Angelchik's reflux prosthesis: long-term results. *Digestive Diseases and Sciences* **30(8):** 723–732.

Kümmerle F & Grönninger J (1984) Operations indikation und Verfahrenswahl bei der Refluxkrankheit der Speiseröhre und bei Hiatushernien. *Chirurgie* **55:** 365–372.

Lackey C & Potts J (1982) Penetration into the stomach: a complication of the antireflux prosthesis. *Journal of the American Medical Association.* **248(3):** 350.

Leonardi HK & Ellis FH (1983) Complications of the Nissen fundoplication. *Surgical Clinics of North America* **63(6):** 1155–1165.

Lerut T, Christians R & Gruvewz JA (1987) The Belsey Mark IV antireflux procedure. In Siewert JR, Hölscher AH (eds) *Diseases of the Esophagus*, pp. 1269–1271. Springer: Berlin.

Maher JW, Hocking MP & Woodward ER (1985) The fate of the intrathoracic fundoplication: review of 112 cases. In DeMeester TR & Skinner DB (eds) *Esophageal Disorders: Pathophysiology and Therapy*, pp 191–195. New York: Raven Press.

Maher JW, Hocking MP & Woodward ER (1986) The results of reoperation for recurrent esophagitis following a previous antireflux procedure. In Siewert JR, Hölscher AH (eds) *Diseases of the Esophagus*, pp. 1255–1258. Springer: Berlin.

Mansour KA, Burton HG, Miller JI & Hatcher Jr CR (1981) Complications of intrathoracic Nissen fundoplication. *Annals of Thoracic Surgery* **32(2):** 173–178.

Narbona B (1986) Pexy with the round ligament Sling approach in the treatment of gastroesophageal reflux: multicentric study (2443 cases). In Siewert JR, Hölscher AH (eds) *Diseases of the Esophagus*, pp. 1172–1177. Springer: Berlin.

Negre JB (1983) Post-fundoplication symptoms. Do they restrict the success of Nissen fundoplication? *Annals of Surgery* **198(6):** 698–700.

Nissen R (1956) Eine einfache Operation zur Behandlung der Refluxösophagitis. *Schweizer Medizinische Wochenschrift* **86:** 590–592.

Orringer MB (1985) The combined Collis gastroplasty Nissen fundoplication for gastroesophageal reflux. In DeMeester TR & Skinner DB (eds) *Esophageal Disorders: Pathophysiology and Therapy*, pp 203–208. New York: Raven Press.

O'Rourke IC (1985) Fundoplication for gastro-oesophageal reflux. *Australian and New Zealand Journal of Surgery* **55:** 347–354.

Payne WS (1984) Surgical management of reflux-induced oesophageal stenoses: results in 101 patients. *British Journal of Surgery* **71:** 971–973.

Peloso OA (1982) Intra-abdominal migration of an antireflux prosthesis. A cause of bizarre pain. *Journal of the American Medical Association* **248(3):** 351–353.

Petterson GB, Bombeck CT & Nyhus LM (1980) Lower esophageal sphincter: mechanisms of opening and closure. *Surgery* **88(2):** 307–314.

Pickleman (1983) Disruption and migration of an Angelchik esophageal antireflux prosthesis. *Surgery* **68:** 467–468.

Postlewaith RW (1986) *Surgery of the Esophagus*, 2nd edn. Norwalk, Connecticut: Appleton-Century-Crofts.

Rogers DM, Herrington JL & Marton C (1980) Incidental splenectomy associated with Nissen fundoplication. *Annals of Surgery* **191:** 153–156.

Saik RP, Greenberg AG & Peskin GW (1977) The study of fundoplication disruption and deformity. *American Journal of Surgery* **134:** 19–22.

Salo JA, Lempinen M & Kivilaakso E (1985) Partial gastrectomy with Roux-en-Y reconstruction in the treatment of persistent or recurrent oesophagitis after Nissen fundoplication. *British Journal of Surgery* **72:** 623–625.

Sapala MA, Sapalla JA, Hurtado MH & Jung JY (1984) A technique for anatomical placement of the Angelchik antrireflux prosthesis. *Surgery, Gynecology and Obstetrics* **158:** 179–180.

Siewert JR & Blum AL (1979) Postsurgical syndromes: the esophagus. *Clinics in Gastroenterology* **8(2):** 271–292.

Siewert JR & Feussner H (1986) Treatment of peptic esophagitis: Nissen repair. In Nyhus LM & Condon RE (eds) *Hernia*, 3rd edn. Philadelphia: JB Lippincott.

Siewert JR & Feussner H (1988) Motility disorders of the esophagus: collagen diseases. In Jamieson GG (ed.) *Surgery of the Esophagus*. Edinburgh: Churchill Livingstone. (in press).

Siewert JR & Weiser HF (1983) Die silikon-prothese als Antirefluxoperation. *Deutsche Medizinische Wochenschrift* **108(42):** 1601–1603.

Siewert JR & Weiser HF (1984) Reinterventionen nach Antirefluxoperationen. *Chirurg* **55:** 373–380.

Siewert R, Jennewein HM, Waldeck F & Peiper HJ (1973) Experimentelle und klinische Ergebnisse der Fundoplikatio. *Langenbecks Archiv für Chirurgie* **333:** 5–21.

Siewert R, Weiser HF, Lepsien G, Schattenmann G & Peiper HJ (1977) Das Teleskop-Phänomen. *Chirurgie* **48:** 640–645.

Skinner DB (1977) Complication of surgery for gastroesophageal reflux. *World Journal of Surgery* **1:** 485–491.

Starling JR, Reicheldorfer MO, Pellet JR & Belzer FO (1982) Treatment of symptomatic gastroesophageal reflux using the Angelchik prosthesis. *Annals of Surgery* **195(6):** 686–690.

Tomás-Ridocci M, Paris F, Carbonell-Antoli C et al (1985) Total fundoplication with or without gastroplasty for gastroesophageal reflux: comparative study. *Annals of Thoracic Surgery* **39(6):** 508–511.

Ulrich B, Mahmud HR, Wienbeck M & Berges W (1981) Hiatushernie – Refluxkrankheit. *Fortschritte der Medizin* **99(17):** 624–628.

Vansant JH & Baker JW (1976) Complications of vagotomy in the treatment of hiatal hernia. *Annals of Surgery* **183:** 629–633.

Wale RJ, Roystone CMS, Bennett JR & Buckton GK (1985) Prospective study of the Angelchik antireflux prosthesis. *British Journal of Surgery* **72:** 520–524.

Watson A (1984) The role of antireflux surgery combined with fiberoptic endoscopic dilatation in peptic esophageal stricture. *American Journal of Surgery* **148:** 346–349.

Weiser HF, Wu YQ & Siewert JR (1984) Supercontinence following antireflux surgery – evaluation by pH-metry. *Digestive Surgery* **1:** 1985–1989.