Assessment of inguinal hernia treatment results in patients operated on with mesh using Lichtenstein, PHS and Robbins-Rutkow techniques

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Abstract

Introduction: *The inguinal region is a locus of minor resistance in the abdominal wall. Hernias in this area occur in the space described as the myopectineal orifice (Fruchaud). Among tensionless hernia repairs the most popular methods nowadays are: Lichtenstein technique, Prolene Hernia System (PHS), ULTRAPRO Hernia System (UHS), mesh-plug and laparoscopic methods (TAPP, TEP). It has not been established yet which one of the methods leads to the best treatment results.*

Aim: *To evaluate treatment results of inguinal hernias in patients operated on with mesh using three techniques: Lichtenstein, PHS and mesh-plug.*

Material and methods: *Between the years 2000 and 2007, 758 men and 35 women were operated on. The mean age was 46.7. Spinal or general anaesthesia was used. One hundred and forty-four patients (18.1%) were operated on without antibiotic prophylaxis.*

Results: *Seven hundred and ninety-three operations were performed: Lichtenstein technique was carried out in 301 patients (37.9%), mesh-plug in 325 patients (40.9%) and PHS in 167 patients (21.2%). Spinal anaesthesia was performed in 787 patients (99.2%). General anaesthesia was necessary in 6 patients (0.8%) due to degeneration of the vertebral column. Complications observed include: wound suppuration, haematoma and seroma formation, chronic pain and hernia recurrence. Patients were discharged on the first postoperative day. Return to physical activity was observed usually 14 days after the operation.*

Conclusions:

1. The analysed methods did not differ according to complication and recurrence rates.
2. In the authors' opinion the Lichtenstein method should remain the standard treatment of inguinal hernia.
3. There are no indications for routine antibiotic prophylaxis in patients undergoing elective hernia operations with mesh.

Key words: *Lichtenstein method, Mesh-plug, Prolene Hernia System, tensionless repair, mesh, chronic inguinal pain.*

Introduction

The inguinal region is a locus of minor resistance in the abdominal wall. Hernias in this area occur in the space described as the myopectineal orifice (Fruchaud). This area is limited from the top and medially by connecting tendon and rectus abdominis muscle, from below by pecten ossis pubis and from laterally by the iliopsoas muscle [1]. Inguinal hernias are a specific group of hernias because of their frequency of occurrence as well as the dynamic development of repair methods. Exact incidence rate and morbidity statistics concerning this disease are unknown. It is estimated that during the lifetime her-

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nia may occur in about 27% of males and about 3% of females [2], which is why over 40-60 thousand hernia operations are performed per year in Poland alone [3, 4]. Increasingly often those operations are performed within one-day surgery units in specialized centres. A correct operation of inguinal hernia is one of the basic skills of every surgeon. Therefore, it is vital to make a choice of the best treatment method, creating a standard procedure based on reliable and current publications, with the economic aspect considered. Based on analyses which have been carried out so far including factors observed in clinical practice, such as frequency of recurrences, intensity of postoperative pain, and postoperative complications, it is considered that the tension methods (Bassini's, Girard's, Halsted's, McVay's) now have a predominantly historical significance.

In the light of the latest research on aetiopathogenesis of hernias, which assigns a key role to disorder of synthesis of collagen and alteration in the proportion of collagen I to III as well as genetically determined qualitative and quantitative changes of collagen in connective tissue [5, 6], it seems that tension methods, in which damaged tissue is replaced by synthetic material, should be recognized as standard. The development of tensionless repair was possible after discovery of synthetic polymers (nylon) made by Wallace Hume Carothers in 1935 and polytetrafluoroethylene (PTFE) by Roy Plunkett in 1938 [7]. Among tensionless hernia repairs the most popular methods nowadays are: Lichtenstein technique, Prolene Hernia System (PHS), ULTRAPRO Hernia System (UHS), Robbins-Rutkow method (mesh-plug) and laparoscopic methods (TAPP, TEP). The latter ones, because of the complexity of the matter and a long learning curve, require separate discussion. The main advantage of repairs using synthetic material is elimination of a cause of hernia formation, which results in a low percentage of recurrences. Furthermore, a proper sewing-in technique and a suitable amount of the synthetic material can reduce post-operative pain and improve patient's life comfort [8, 9].

Currently, according to the American College of Surgeons, the Lichtenstein technique, developed in 1984-1988 [10], is considered the gold standard. It is based on sewing in a synthetic material (mesh), which fulfils defect of tissue in the inguinal canal posterior wall area, reaching beyond Hasselbach's triangle (after the surgery the mesh becomes reduced by about 20% in each direction). The Lichtenstein technique is frequently performed within one-day surgery which allows reduction of treatment costs. It is also important that the percentage of recurrences and complications is low. In published reports it does not exceed 1%.

An increasingly popular opinion among surgeons involved in hernia repair operations is the conviction that placing the entire mesh plug into the preperitoneal space is necessary [11]. Totally extra-peritoneal (TEP) laparoscopic operations, Robbins-Rutkow method and PHS and UHS methods enable this approach. These techniques rely on placing synthetic material in the preperitoneal space and the hernia orifice and reconstructing the inguinal canal posterior wall. In the Robbins-Rutkow method it is a prolene plug, shuttlecock-shaped, which is sewn into the hernia orifice (it may be in two sizes) with additional mesh located on the inguinal canal posterior wall (it is similar to the Lichtenstein method). In PHS and UHS methods there are prolene patches with a connector which are placed in the hernia orifice. One of them is put in the preperitoneal space, and the other reconstructs part of the inguinal canal posterior wall. The benefits of placing mesh plug into the preperitoneal space and reconstructing the defect in the inguinal canal posterior wall at the same time are visible in those procedures. Laparoscopic totally extraperitoneal repair of inguinal hernia (TEP), because of difficulties in its performance, is usually carried out in specialized centres. During such an operation, it is important to separate an appropriate amount of space (between posterior and anterior layers of the transversalis fascia) and to dissect the hernial sac. There are required 3 or 4 trocars, and polypropylene mesh (size: 15 × 15 cm or 15 × 10 cm) which should cover the whole myopectineal orifice. Use of staples to bind the prosthesis is not necessary, because its stabilization is secured by intra-abdominal pressure according to Pascal's law (in supine position the pressure is about 8 cm H_2O and increases in standing position to 12 cm H_2O; while straining [pushing] or vomiting it may increase up to 80 cm H_2O) [12-14].

Aim

As there are plenty of methods available when it comes to tensionless repair of inguinal hernias using mesh, it is necessary to compare them and to choose the most applicable one. The aim of this work is to evaluate the results of treatment of inguinal hernias

with three methods (Lichtenstein, Robbins-Rutkow, PHS), which was done by comparing the percentage of early complications, localized and general; the presence of discomfort or chronic pain caused by implanting an artificial material; and recurrence rates.

Material and methods

A retrospective analysis concerning 758 men and 35 women was made, based on medical documentation of the First Chair of General Surgery, UJ CM, Clinic of Gastroenterological Surgery and Specialist Diagnostic and Therapeutic Centre Medicina in Cracow in the years 2000-2007. All three methods (Lichtenstein, Robbins-Rutkow, PHS) were applied. The average age was 46.7 years. Six hundred and forty-nine patients (82%) were given antibiotic prophylaxis (pefloxacin 400 mg *i.v.*). The evaluation of relevant parameters such as the number of localized complications, hernia recurrence rate, pain or subjective discomfort were done during post-operation consultations. The average observation time was 12 months (between 4 and 18 months). The results were compared using Fisher's test and with Statistica 8.0 software. $P < 0.05$ was considered significant.

Results

During 8 years 793 operations with mesh were performed, including 301 (37.9%) with Lichtenstein technique, 325 (40.09%) with Robbins-Rutkow (mesh-plug) and 167 (21.2%) with PHS. All patients were operated on by the same team of surgeons. The choice of treatment method was made during the operation – in the case of indirect inguinal hernias with non-extended internal inguinal ring (hernia sac located in inguinal canal), the procedure was performed with the Robbins-Rutkow method. Patients with direct inguinal hernia were operated on with the Lichtenstein method. In the case of direct or indirect hernias with large hernia porta or considerable defect of transversalis fascia in the inguinal triangle (Hasselbach's triangle) the hernia repair was performed with PHS. Spinal anaesthesia was performed on 787 patients (99.2%). General anaesthesia was necessary in the case of 6 patients (0.8%) due to degeneration of the vertebral column. No additional local anaesthesia was necessary for patients in whom spinal anaesthesia was applied. Operations were carried out in one-day procedures. Patients resumed everyday activity on the first postoperative day. Return to full physical activity was observed usually 14 days after the operation.

Complications observed after procedures include: wound infection, haematoma and seroma formation, chronic pain and hernia recurrence (see Table I). After reconstructive operations done with the Lichtenstein method wound suppuration appeared in 8 patients (2.6%), haematoma in 3 patients (1%) and seroma formation in 2 patients (0.6%). After PHS procedure wound infection was observed in 6 patients (3.5%), haematoma in 3 patients (1.8%) and seroma formation in 1 patient (0.6%). After mesh-plug operation wound suppuration occurred in 10 cases (3%), haematoma in 5 cases (1.5%) and seroma formation in 2 cases (0.6%). Infections of the operated area were superficial, did not concern implanted material or fascia and were successfully cured after applying guided antibiotic treatment. Haematomas arising in the wound were emptied, compression, as well as gel containing heparin, was applied, and no further complications were observed.

Hernia recurrence was observed in 8 patients (1%), 4 (1.4%) of whom were operated on with Lichtenstein, 2 (1.2%) with Robbins-Rutkow and 2 (0.6%) with PHS method. The differences between the frequency of recurrence in the three analysed methods were statistically insignificant.

Table I. Early and remote complications of treatment of inguinal hernias

Complications *N* = 793	Mesh-plug *N* = 325, *n* (%)	PHS *N* = 167, *n* (%)	Lichtenstein *N* = 301, *n* (%)	Value of *p*
Wound suppuration	10 (3.0%)	6 (3.5%)	8 (2.6%)	0.85
Haematoma	5 (1.5%)	3 (1.8%)	3 (1.0%)	0.74
Seroma	2 (0.6%)	1 (0.6%)	2 (0.6%)	0.99
Chronic pain	2 (0.6%)	1 (0.6%)	3 (1.0%)	0.83
Recurrence	2 (0.6%)	2 (1.2%)	4 (1.3%)	0.64

Chronic inguinal pain (i.e. a pain that continues for at least 3 months according to the definition proposed by the *International Association for the Study of Pain* – IASP [15]) was diagnosed in 6 patients (0.6%), including 3 (1%) treated with Lichtenstein, 2 (0.6%) treated with mesh-plug and 1 (0.6%) treated with PHS.

Discussion

The only effective method of treating hernia is operation. The open operation of inguinal hernia consists in dissection of the hernial sac of the structures of the spermatic cord, emptying the content of the sac, cutting out or dislocating the sac, and reconstructing and strengthening the back wall of the inguinal canal. These procedures are among the most frequent surgical performances. Therefore it is not only a medical, but also a social and economic problem. The constant research for more and more perfect methods of treatment is no surprise then. The introduction of tensionless repairs using synthetic material was a breakthrough in this field. They supplanted tension repairs, mainly because of the considerably smaller percentage of recurrence (the frequency of recurrence decreased by over 30% to about 1%). The quoted results of treating hernia obtained by the authors of the present article confirm this observation. The methods that use mesh – Lichtenstein, mesh-plug and PHS – supplanted previously applied tension repairs. The percentage of patients with recurrence in the analysed group was below 1.5%. Mittelstaedt *et al*. of Sao Paulo University carried out a clinical prospective randomised study with participation of 119 patients, which aimed to evaluate the results of treatment of inguinal hernias with three tension repairs: Bassini's, Shouldice's and McVay's. During four years' observation 35.7% of patients treated with Bassini's method, 23.7% treated with Shouldice's and 8.5% treated with McVay's experienced a hernia recurrence [16]. Liem *et al*., in a trial whose results were published in 2003, stated that the relative risk of hernia recurrence after applying Bassini's method was 3.59 (95% confidence interval 1.96-6.57; $p < 0.00005$) and thus was unacceptably high [17]. Still, in numerous trials evaluating the results of treating inguinal hernias with tensionless repair the percentage of recurrence was usually below 1%. Such a low percentage of recurrence in patients treated with the Lichtenstein method was obtained by, inter alia, Sanjay *et al*. (0% recurrence during 4 years; observation [18]), Pokorny *et al*. (0% recurrence during 3 years' observation [19]) and Butters *et al*. (1.1% recurrence during 4 years' observation [9]).

In the analysed material no significant differences were found between the Lichtenstein technique and others (PHS, mesh-plug). The percentage of recurrence, the number of local complications, the intensification of pain complaint after the performance and the time of the return to full physical activity were comparable. Other authors also confirm this statement [18, 20, 21]. There is no full agreement on which of the methods is the best. There are some letters that point out that the PHS technique is characterised by a lower number of recurrences or complications such as haematoma or seroma in the wound [22, 23]. In our material this theory has no confirmation. According to the authors' opinion the final choice of treatment technique depends on intraoperative evaluation and ability of the surgeon to perform a given method. PHS/UHS technique should be used with patients with considerable defect of the back wall of the inguinal canal, especially in the young and people working physically. Table II presents randomised trials comparing the treatment methods which are also the subject of the present article.

Table II. Randomised clinical trials comparing open techniques of tensionless repair of inguinal hernias using mesh

Author, year of publication	Number of patients	Treatment technique	Recurrence percentage [%]	Chronic pain [%]
Nienhuijs, *et al.,* 2005 [20]	334	Mesh-plug vs. PHS vs. Lichtenstein	2.5; No difference between methods	43.3; No difference between methods
Sanjay, *et al.,* 2006 [18]	64	PHS vs. Lichtenstein	3 vs. 0	12.9 vs. 15.1
Frey, *et al.,* 2007 [24]	597	Mesh-plug vs. Lichtenstein	1 vs. 1.6	3.1 vs. 4.2

Nienhuijs *et al.*, in a trial carried out with the participation of 334 patients, compared the techniques of treating inguinal hernias with three tensionless repairs. They did not report any differences between analysed groups as to frequency of recurrence. After a period of observation, which was usually 15.4 months long, complaint of pain was observed in 43.3% of patients and pain severity (over 50 points on VAS [*Visual Analogue Scale*] scale) in 14.5% of patients. No significant differences were observed in the frequency of pain depending on applied treatment method. However, a positive correlation between chronic pain and intensification of pain during the first two postoperative weeks and a negative correlation between chronic inguinal pain and age were found (correlation coefficient $r = 0.3$ and $p < 0.001$ for each of the quoted dependences) [20]. English authors (Sanjay *et al.*) compared the percentage of recurrence between patients treated with Lichtenstein and PHS methods. During the average observation period of 4.2 years, no recurrence in patients operated with Lichtenstein technique occurred, and among patients operated on with PHS recurrence occurred only in one patient (3%). The frequency of chronic pain was similar in both analysed groups [18]. Frey *et al.* from three Swiss centres published the results of a randomised trial with the participation of 594 patients with 700 hernias. The patients were cured with Lichtenstein or mesh-plug techniques and were observed for 12 months. The percentage of recurrence in both groups was low and was respectively 1.6 and 1% ($p = 0.425$). The frequency of chronic pain was also similar, regardless of applied method ($p = 0.522$) [24]. The results of trials quoted above are analogical to the results obtained in the present study and confirm the efficacy of all analysed tensionless repairs in treating inguinal hernias using synthetic material. In the authors' opinion, despite many currently applied and introduced methods, the Lichtenstein technique still remains a "gold standard" for treating inguinal hernias, because it is relatively simple and at the same time an effective and safe solution.

Laparoscopic techniques, both from the abdominal approach (TAPP) and entirely preperitoneal approach (TEP), allow placement of mesh in the preperitoneal space by the very fact of closure of hernia portas within the Fruchaud orifice. According to the authors of the present trial laparoscopic surgery should be performed primarily in specialised centres and mainly to treat recurring and bilateral hernias. The unquestionable advantages of laparoscopic technique are repair of all potential loci of hernia formation (i.e. indirect, direct, femoral), smaller postoperative wound (little risk of suppurative complications), possibility of faster return to full activity, and greater comfort in the postoperative period. The disadvantages of the mentioned techniques, on the other hand, are: high costs of the procedure, prolonged time of performance, and a relatively long learning curve. Based on the data available in the literature, it can be stated that both the percentage of recurrence and the prevalence of chronic pain are similar regardless of technique (laparoscopic or Lichtenstein). The results from some trials are presented in Table III.

The return to full physical activity happened on average after 14 days from surgery and did not differ according to the adopted method. This observation is confirmed by other authors [18, 21, 23]. While analysing the results of treatment in the period between 1990 and 2007 it was found that sewing in of mesh contributed to shortening this period from an average of 4-6 weeks to a fortnight.

Repair of hernia is classed as so-called clean surgery, alongside procedures concerning breast or thyroid. The frequency of wound infection ranges from 0.06 to 5.3%, averaging 3% [25]. The use of artificial material triggered off a discussion about preventive

Table III. Comparison of results of hernia treatment with laparoscopic surgery and Lichtenstein method

Author, year of publication	Number of patients	Treatment method	Recurrence percentage [%]	Chronic pain [%]
Douek, *et al.,* 2003 [26]	374	TAPP vs. Lichtenstein	1.6 vs. 2.5	0 vs. 5
Grant, *et al.,* 2004 [27]	928	TEP vs. Lichtenstein	No data	2.1 vs. 1.5
Eklund, *et al.,* 2007 [28]	147	TAPP vs. Lichtenstein	19 vs. 18	0 vs. 0
Hallen, *et al.,* 2007 [29]	168	TEP vs. Lichtenstein	4.3 vs. 5.1	5.5 vs. 2.5

use of antibiotic therapy again. Opinions as to the sense of its usage are still divided. The majority of authors believe that there are no indications to use preventive antibiotherapy with elective repair of inguinal hernia using mesh [25, 30-33]. The study carried out in Amsterdam in the years 1998-2003 can serve as an example. One thousand and forty cases of patients treated with the Lichtenstein technique were analysed. In the group where preventive antibiotic therapy was applied, the percentage of wound infection was 1.6% and in the placebo group 1.8% [34]. However, on the basis of a meta-analysis published in 2007, which included data considering 2507 patients, it was stated that preventive antibiotherapy reduces the frequency of infection of the operated locus by almost 50% (frequency of infection in patients who were given prophylaxis 1.38%, and in the control group 2.89%; odds ratio 0.48 with 95% confidence interval 0.27-0.85) [25]. The discussion about this subject remains open, though. It should be emphasised that infection of the wound is not tantamount to the necessity to remove the mesh. In the majority of cases prolonged antibiotic therapy and drainage of the wound allow the patient to be cured without removing the mesh.

In our material the percentage of localised complications in the form of infection of the wound was 2.6-3.5%. Among the group of 144 patients operated on without preventive antibiotherapy (18.1%) no greater frequency of infectious complications was observed. In references the view that antibiotics should be applied preventively only, when risk factors subsist, predominates. Risk factors include: age (over 70 years of age), sex (more often in women), comorbid illnesses, and low level of personal hygiene. In remaining cases the administration of antibiotics is unnecessary. This opinion is shared by the authors of the present study, who consider that there is no indication for preventive use of antibiotics in all patients who undergo an elective procedure. In Table IV a few clinical randomised trials are presented in which the value of preventive antibiotic therapy in treating hernias with open techniques is evaluated.

Subarachnoid anaesthesia was applied to 787 patients (99.2%). General anaesthesia was applied to the remaining 6 (0.85%), because of the presence of degenerative changes of the vertebral column. In the opinion of the authors, subarachnoid anaesthesia is an effective and safe way of anaesthesia in inguinal hernia surgery. A fast onset and reliability are among its other benefits. It guarantees proper comfort both for the patient and the operating team. It is worth stating that the technique of anaesthesia has no influence on incidence of chronic pain in the patients [35, 36]. Among operated patients, application of additional local anaesthesia was not necessary. However, subarachnoid anaesthesia is not faultless. A postdural puncture headache, neurological disorders and urine retention may be observed, but they are very rare, as is confirmed by our material.

Chronic inguinal pain following inguinal hernia repair poses a significant post-operative problem. Occurrence and intensity of pain may be a reason for the patient's dissatisfaction with treatment results, even though there were no other complications. Intensity of pain, to some extent, depends on the chosen technique – it may be more severe after the use of tension repair. In the cited literature, the frequency of occurrence of chronic pain varies from 2 to 53% [37-39]. Women are at greater risk of occurrence of chronic inguinal pain than men [40]. Location of the pain varies; it depends on the technique used. After laparoscopic methods the pain usually appears in the testis, whereas after open surgery pain may be

Table IV. Clinical randomised trials considering preventive antibiotic therapy in treatment of inguinal hernias using mesh

Author, year of publication	Applied antibiotic	Frequency of wound infection [%]		Value of *p*
		Prophylaxis	Control group	
Yerdel, *et al.,* 2001 [41]	Ampicillin + Sulbactam 1.5 g	0.7	9	0.002
Aufenacker, *et al.,* 2004 [34]	Cefuroxime 1.5 g	1.6	1.8	0.81
Perez, *et al.,* 2005 [42]	Cefazolin 1 g	2.2	3.9	0.54
Tzovaras, *et al.,* 2007 [32]	Amoxicillin + Clavulanic acid 1.2 g	2.6	4.7	0.40

noticed in the groin. Based on a meta-analysis of 41 clinical studies with the participation of 7161 patients, it was concluded that the frequency of chronic pain and paraesthesias in the groin area is lower after laparoscopic procedures compared to open methods [43]. Researchers from *EU Hernia Trialist Collaboration*, based on a literature review, demonstrated that the incidence of chronic pain is lower after open operation using mesh and after laparoscopic TAPP and TEP repair in comparison to operations without the use of synthetic materials [3]. In one randomized clinical trial the three mesh-based methods were compared and the researchers stated that chronic inguinal pain more often affected younger patients and patients who suffered from severe soreness directly after the operation. There were no differences found regarding chronic pain between the three examined tensionless methods [20]. In a Polish multicentre study (*Polish Hernia Study Group*) with 392 patients it was found that intensity of pain was lower after 7 days ($p < 0.001$) and after 3 months ($p = 0.033$) when using lightweight mesh in comparison to traditional polypropylene mesh. Nevertheless, after 12 months the patients presented similar data, which shows that the use of synthetic materials results in diminishing of pain and limiting of analgesics administered postoperatively [44]. In the past patients who underwent hernia repair by tension methods were given analgesics for 10-14 days. This is not valid these days because of tensionless and mesh technique which enables that time to be shortened to 3-5 days. Observed intensity of postoperative pain was irrespective of the administered methods. Proper technique of surgery consisting of exposing and protecting nerves in the affected area seems to be the best measure to prevent chronic pain.

Conclusions

Having analysed all the collected material it was found that there are no significant differences in frequency of complications and frequency of recurrence between Lichtenstein, mesh-plug and PHS methods. In the authors' opinion the proper choice of operational technique is based on intraoperative evaluation of the hernia, anatomical conditions and experience of the surgeon in employing a given method. It guarantees efficacious treatment and few complications, including recurrence. The presence of discomfort in the groin or chronic inguinal pain, causing obstruction of normal functioning of patients, seems to be relevant mainly to the technique of implantation of mesh itself (damage to one of the three nerves located in the groin).

Currently a dominant opinion states that there are no indications for preventive antibiotic therapy in patients with low infectious complication risk operated on with mesh, including Lichtenstein, PHS and mesh-plug techniques [25, 30-33]. The authors are of the view that antibiotics should be administered preventively to patients who are over 70 years old and burdened by other illnesses (e.g. diabetes, hepatic cirrhosis, during steroid therapy or immunotherapy), the obese and persons with a low level of personal hygiene.

All analysed methods guarantee effective repair of inguinal hernia, resulting in a relatively low rate of recurrence and complications. Lichtenstein technique should however remain a "gold standard" in treatment of inguinal hernias, because it is an effective, safe method associated with comparatively low costs and having a steep learning curve (so it is quickly learnt).

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