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ORIGINAL ARTICLE

Jörg Köninger
Jens Redecke
Michael Butters

Chronic pain after hernia repair: a randomized trial comparing Shouldice, Lichtenstein and TAPP

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J. Köninger · J. Redecke · M. Butters
Allgemeinchirurgische Abteilung,
Krankenhaus Bietigheim,
Bietigheim-Bissingen, Germany

J. Köninger (✉)
Department of General Surgery,
University of Heidelberg,
Im Neuenheimer Feld 110,
69120 Heidelberg, Germany
e-mail:
joerg_koeninger@med.uni-heidelberg.de
Tel.: +49-6221-5636244
Fax: +49-6221-566903

Abstract *Introduction:* Chronic pain after hernia repair is common, and it is unclear to what extent the different operation techniques influence its incidence. The aim of the present study was to compare the three major standardized techniques of hernia repair with regard to postoperative pain. *Patients and methods:* Two hundred and eighty male patients with primary hernias were prospectively, randomly selected to undergo Shouldice, tension-free Lichtenstein or laparoscopic transabdominal pre-peritoneal (TAPP) hernioplasty repairs. Patients were examined after 52 months with emphasis on chronic pain and its limitations to their quality of life. *Results:* Chronic pain was present in 36% of patients after Shouldice repair, in 31% after Lichtenstein repair and in 15% after TAPP repair. Pain correlated with physical strain in 25% of patients after Shouldice, in 20% after Lichtenstein and in 11% after TAPP repair. Limitations to daily life, leisure activities and sports occurred in 14% of patients after Shouldice, 13% after Lichtenstein and 2.4% after TAPP repair. *Conclusion:* Chronic pain after hernia surgery is significantly more common with the open approach to the groin by Shouldice and Lichtenstein methods. The presence of the prosthetic mesh was not associated with significant postoperative complaints. The TAPP repair represents the most effective approach of the three techniques in the hands of an experienced surgeon.

Keywords Groin hernia · Tension-free repair · Shouldice · Lichtenstein · TAPP

Introduction

Hernia repair is one of the most common surgical procedures, and postoperative recovery is uncomplicated in most patients. The introduction of the tension-free techniques has led to very low recurrence rates and such techniques seem to produce postoperative pain less frequently [1–3]. Some patients, however, fail to arrive at a complete reconstitution after surgery and suffer from chronic discomfort and pain [4].

The incidence of chronic pain following hernia repair is not accurately known. Different studies report frequencies of up to 40%, but observational methods vary, and prospective studies are few [4–8].

There is much speculation about the cause of chronic pain after hernia surgery, and several risk factors have been identified, such as recurrence, patient's age and resection of the cremasteric muscle, experience of the surgeon and the presence of pre-operative pain. The influence, however, of different surgical techniques remains unclear [3, 4, 9–24].

Dissection of the groin by an anterior approach is more traumatic than the laparoscopic approach. Both open techniques, Shouldice and Lichtenstein, are associated with possible injury to peripheral nerve structures and scarring of the abdominal wall [25]. Nerve injury during laparoscopic hernia repair, especially to the nervus cutaneus femoris lateralis has also been reported, especially at

the beginning of the laparoscopic repair era, but seems to be avoidable with the correct operating technique [21]. Tension-free techniques and especially laparoscopic repair, seem to be less painful in the early postoperative period [3, 12, 26], but there is no evidence as to whether the presence of the prosthetic mesh itself may be the source of postoperative complaints [3, 22, 27–29].

In this study, the patients were randomly assigned to three different groups and were operated on by Shouldice, Lichtenstein or laparoscopic transabdominal pre-peritoneal (TAPP) techniques. Follow-up occurred within 52 months. Attention focused on development of chronic pain and its influence on patients' physical endurance and their quality of life.

Patients and methods

In a time interval of 12 months 280 male patients with primary hernias were selected and randomly assigned to three different groups. Informed consent was taken from all the patients before surgery. Randomization was by sealed envelope. The groups were matched by age and body mass index (Table 1). Ninety-three patients in group 1 were operated on by the Shouldice technique [30], 93 patients (group 2) by the tension-free Lichtenstein technique [31] and 94 patients (group 3) by the laparoscopic TAPP technique [32]. The patients were operated on by three surgeons experienced in both conventional and laparoscopic techniques (>100 TAPP, Lichtenstein and Shouldice interventions each). Mesh fixation in the laparoscopic group was performed with between four and six titanium clips (EMS Herniostate; Ethicon) with strict avoidance of clips in the area distal of the ileopubic tract. In the case of the Lichtenstein technique the mesh was fixed with a running suture (4/0 Prolene) to the inguinal ligament. All patients were operated on under general anaesthesia and received one dose of amoxicillin/clavulanic acid preoperatively. Patients were followed within a median of 52 months (range 46–60) in face-to-face interview by a surgical resident. Attrition was 15.7%: 15 patients died of unrelated causes, and 28 patients moved to unknown addresses or would not participate.

The patients were assessed for intensity, character and frequency of discomfort and pain, pain associated with physical strain and for limitations to daily life and physical activities. A standardized interview form was used to obtain objective and comparable results (Table 2). A visual analogue scale (VAS; a scale from 0 to 100) was used to measure discomfort and pain.

Statistics. Data obtained from the VAS were subjected to statistical analysis (zero hypothesis) by two-sided Fisher exact test. A P value <0.05 was regarded as significant.

Results

Table 3 shows the results of patient interviews. There was a significant difference in pain perception between open and laparoscopic approaches. Eighty-four per cent of the patients in group 3 (TAPP) had no pain, compared with 62% and 68% in groups 1 and 2 (Shouldice and Lichtenstein, respectively). Twenty-two per cent and 24% in groups 1 and 2, respectively, described slight discomfort and pain, compared with 15% in group 3. Pain of medium intensity was described by 13% and 5% in groups 1 and 2, respectively, and 1% in group 3. Intense pain was described by 3% in groups 1 and 2 and by none of the

Table 1 Patient data

Procedure	Number	Age (years)[a]	BMI	Follow-up (%)	Months after surgery[a]
Lichtenstein	93	53 (26–74)	25.7 (18.4–32.1)	76 (84)	51 (46–59)
Shouldice	93	56 (25–75)	25.2 (17.7–36.7)	74 (82)	54 (47–59)
TAPP	94	53 (30–74)	25.4 (20.6–30.3)	81 (86)	52 (46–60)

[a] Values are median (range)

Table 2 Hernia follow-up questionnaire

Question	Choices
Do you have any discomfort or pain in the operated-on groin after hernia repair? If yes, assign it to the following descriptions	I have only slight discomfort I have moderate pain I have severe pain in the operated-on groin
What degree of physical exertion provokes your pain/discomfort? Please assign it to the following descriptions	Pain is not related to physical exercise I feel pain only under severe physical stress (carrying heavy loads, intensive sporting activities) Pain usually occurs with medium physical stress (going upstairs or downstairs, entering a car, dancing etc.) Pain usually occurs with mild physical exercise (walking without heavy load)
To what degree does pain in the groin limit your daily activities?	I do not feel as well as I used to due to pain in the groin Since the operation I have been unable to go to work I find myself limited in daily life and social activities (walking, carrying bags of groceries, dancing) I find myself limited in sports I have abandoned sporting activities

Table 3 Complaints after hernia surgery

Level of pain	Shouldice (*n*=74)	Lichtenstein (*n*=76)	TAPP (*n*=81)
None	46 (62.2%)	52 (68.4%)	68 (84%)
Slight	16 (21.6%)	18 (23.7%)	12 (14.8%)
Moderate	10 (13.3%)	4 (5.3%)	1 (1.2%)
Severe	2 (2.7%)	3 (3.9%)	–

Table 4 Complaints after hernia surgery, measured on the visual analogue scale

Scale	Shouldice (*n*=74)	Lichtenstein (*n*=76)	TAPP (*n*=81*)
01–20	11 (14.9%)	11 (14.5%)	11 (13.6%)
21–40	12 (14.9%)	9 (11.8%)	1 (1.2%)
41–60	3 (4.1%)	4 (5.3%)	–
61–80	2 (2.7%)	1 (1.3%)	1 (1.2%)
81–100	–	–	–

* $P<0.01$

patients in group 3. The VAS median value for Shouldice repair was 35 (range 10–75), for Lichtenstein repair it was 33 (range 10–73) and for TAPP the mean value was 15 (range 10–68). For VAS values of less than 20 (corresponding to minor discomfort) there was no difference between the three groups.

For VAS values above 20, results after Shouldice and Lichtenstein did not differ significantly. Comparison of both those techniques with TAPP showed the values for TAPP to be significantly lower ($P<0.01$), and this was more evident with rising levels of pain (Table 4).

In the majority of patients, pain correlated with physical strain (Table 5). Again, patients who had undergone the TAPP procedure had fewer complaints related to physical activity and tolerated relatively high levels of physical exertion. No patient, after laparoscopic repair, experienced pain after light physical exercise. Eight patients from both groups after Shouldice and Lichtenstein repair described pain under moderate physical stress, compared to one patient after TAPP.

Table 6 shows limitations in daily life, leisure activities and sports after hernia repair. Fifteen per cent and 13% of the patients after Shouldice and Lichtenstein repair, respectively, found themselves limited when performing physical activities, compared to 2.4% of the patients after TAPP. Two patients each from groups 1 and 2 were limited in social activities or were unable to go to work. After TAPP (group 3) none of the patients that experienced chronic pain found themselves thereby limited in daily life activities. Moderate limitations in leisure activities were more frequent after the Shouldice and Lichtenstein approaches than after TAPP.

There were no complaints related to the insertion of the prosthetic mesh in the Lichtenstein and TAPP methods. No-one complained about the feeling of a foreign body, stiffness or rigidity in the region of the mesh implant.

Discussion

Hernia repair is one of the most frequently performed surgeries. The implementation of the so-called tension-free techniques has considerably contributed to the fact that even large or recurrent hernias can be repaired in a very dependable way [3, 5, 12]. However, now that the problem of recurrence has been substantially resolved , chronic pain after surgery has been receiving more attention.

Several risk factors have been identified to play a crucial role in the development of chronic pain [9], but the long-term influence of the different approaches to the groin and the presence or absence of a prosthetic mesh on long-term complaints is not clear [25]. Current studies of postoperative pain after hernia repair are difficult to compare, due to, mostly, retrospective, non-randomized designs and relatively short follow-ups. Furthermore, there is no randomized trial that compares a laparoscopic technique simultaneously with the two major standardized

Table 5 Relation of complaints and pain to physical stress

Parameter	Shouldice (*n*=74)	Lichtenstein (*n*=76)	TAPP (*n*=81)
Independent	9 (12.2%)	5 (6.6%)	4 (4.9%)
Severe physical stress	10 (13.5%)	10 (13.4%)	7 (8.6%)
Medium physical stress	4 (5.4%)	5 (6.6%)	1 (1.2%)
Light physical stress	4 (5.4%)	3 (3.9%)	–
Rest pain	1 (1.4%)	2 (2.6%)	1 (1.2%)

Table 6 Limitations in daily life, leisure activities and sports

Limitation	Shouldice (*n*=74)	Lichtenstein (*n*=76)	TAPP (*n*=81)
Less capable	11 (14%)	10 (13%)	2 (2.4%)
Unable to work	–	2 (2.6%)	–
Limitations in social activities	2 (2.7%)	–	–
Slightly limited in sports	7 (9.5%)	4 (5.3%)	–
No sports	1 (1.4%)	2 (2.6%)	1 (1.2%)

and established representatives of open surgery, Shouldice and Lichtenstein repair, which would allow the estimation of the influence of the different techniques on the development of chronic pain.

Our study attempted to address two questions. First, the influence of the type of approach to the groin (open or laparoscopic), and, second, the principle of repair (non-mesh repair or tension free).

The laparoscopic approach to the groin is surely less traumatic than the open techniques. In the case of the TAPP technique, it involves only the incision of the peritoneum and the preparation of the hernial sac, without major trauma to the abdominal wall, thus minimizing the risk of possible nerve injury and concomitant scarring [20]. This was confirmed by our data, and we concurred with other studies where the laparoscopic techniques were shown to cause less pain postoperatively [20, 33–35]. However, the laparoscopic techniques are more technically complex and have a very long learning curve [36]. It is essential that this fact be borne in mind when one is comparing the results of the different techniques, and for explaining the heterogeneous outcome of studies that are comparing the laparoscopic procedure with the technically less demanding open techniques. Our data regarding the results after TAPP seem to be better than those described in other studies, but we started this trial after having performed approximately 300 TAPP interventions at our clinic.

The majority of studies that compare mesh repair with non-mesh repair with regard to postoperative pain, physical activity or early return to work and leisure activities show significantly better results for the tension-free techniques [3, 21, 26, 37]. However, it is important for one to notice that the difference between Shouldice and the open tension-free Lichtenstein technique is not as evident as that between Shouldice and laparoscopic repair [26, 33, 38]. Furthermore, there is a difference in postoperative discomfort and pain after the two tension free-techniques in favour for the laparoscopic technique, although not as evident as that between Shouldice and TAPP [20, 34, 39, 40]. This indicates that the approach to the groin, and not only the tension-free principle, is also a crucial factor for postoperative comfort in hernia repair.

The important question is whether this holds true in the long run. Especially in the case of large or recurrent hernias, the tension-free techniques are an indispensable part of the surgeon's armamentarium of a reliable repair. However, there are some uncertainties about the long-term behaviour of the implanted meshes. The commonly used (and also used in this study) heavyweight polypropylene meshes provoke a chronic inflammatory response [41]. Although there is really no serious indication in the literature about possible malignant transformation, the behaviour of the prosthetic mesh as a foreign body, with all its implications such as shrinkage and scarring, might be a risk factor for the development of chronic pain itself [18].

Chronic discomfort and pain in up to 40% of the patients after hernia surgery reflects serious surgical reality [4, 33]. The most common chronic pain syndrome correlates with physical stress and can be reproduced readily with manoeuvres that typically provoke abdominal-wall pain. There is some evidence that the reason for those complaints lies partly in the region of the medial inguinal ligament, where sutures involve pubic periostal structures, and the physiological tensing of this ligament then leads to pain [14]. The remarkable finding in our study was that, more than 4 years after surgery, both character and intensity of pain after the open techniques were similar. With regard to the discussion about the potential disadvantage that results from the implantation of a relatively rigid prosthetic mesh, and possible cicatrization and shrinking due to chronic inflammation, one may have expected similar complaints after both tension-free techniques, independently of whether the mesh was implanted by an anterior or posterior approach. This supports the hypothesis that the surgical trauma to the groin plays a crucial role in the development of chronic pain.

Conclusion

The incidence of postoperative pain after hernia repair differed with the type of surgical approach. The technically demanding laparoscopic TAPP repair resulted in a significantly lower frequency of postoperative pain than did the open Shouldice and tension-free Lichtenstein procedures. The presence of a prosthetic mesh was not the source of any complaints during the approximately 4 years of follow-up.

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