

CASE REPORT

Prophylaxis and treatment of acute and chronic postoperative inguinal pain (CPIP)—association of pain with compression neuropathy[†]

René Gordon Holzheimer^{1,*} and Nikolai Gaschütz²¹Surgeon/Sportsmedicine - Chirurgische Tagesklinik Sauerlach/München – Ludwig-Maximilians-Universität München Germany – Sant Anna Klinik Meran Italy, and ²General Practitioner D-97500 Ebelsbach*Correspondence address: Prof. Dr. René G. Holzheimer, Praxisklinik Sauerlach/München, Tegernseer Landstr. 8, D-82054 Sauerlach.
Tel: +49-8104-668454; Fax: +49-8104-668453; E-mail: rgholzheimer@t-online.de www.praxisklinik-sauerlach.de

Abstract

Can open inguinal hernia repair (OIHR) and tailored neurectomy (TN) be effective for prophylaxis of chronic postoperative inguinal hernia repair (CPIP) (I) and treatment of CPIP (II)? Patients with symptomatic primary inguinal hernia (I group 1) and secondary hernia with CPIP (II, groups 2–5) were investigated for postoperative complications and nerve damage. About, 98% of patients with OIHR with TN reported preoperative pain (I group 1, $n = 388$, recurrence rate 1%). There were 73 cases (II) of CPIP after laparoscopic inguinal hernia repair (LIHR) (group 2, $n = 22$), OIHR (group 3, $n = 37$), LIHR followed by OIHR/LIHR (group 4, $n = 5$) and OIHR followed by LIHR/OIHR (group 5, $n = 9$). The results were as follows: preoperative pain: 33–100%, recurrence rate 0–11% (II, groups 2–5), nerve damage 92–100% and persistent CPIP: $n = 1$ after trocar perforation of inguinal nerve elsewhere. OIHR is effective to avoid CPIP with compression neuropathy. This is the largest series of histological nerve damage in CPIP.

INTRODUCTION

The rate of chronic postoperative inguinal pain (CPIP) may affect up to 62% of patients [1]. Nerve entrapment was recognized as a major cause of chronic groin pain as early as 1942, but the pathogenesis of chronic groin pain and clinical problem remained unknown and largely unrecognized until recently [2]. Iatrogenic nerve injury and nerve entrapment by surgical mesh or scar tissue have been reported to be the leading cause of CPIP [3]. Open inguinal hernia repair (OIHR) has been considered as a risk factor for nerve injury/entrapment. Consecutively, it has been argued that laparoscopic inguinal hernia repair (LIHR) should be the first step to avoid CPIP. There are controversial results in randomized controlled trials and systematic reviews/meta-analyses with regard to risk factors for CPIP [4]. Recently, authors

have reported that preoperative pain may have an impact on CPIP. It has been the purpose of this study to analyze the results of symptomatic primary OIHR with tailored neurectomy (TN) with regard to recurrence, pain, complications and histological signs of nerve damage. With regard to CPIP, we investigated the outcome (recurrence, pain, complications) of OIHR combined with TN and/or mesh removal in patients who were treated elsewhere by LIHR and/or OIHR as index operation (IO) and had indicated preoperative pain before IO.

CASE SERIES

From 2007 to 2017 patients with preoperative pain, primary OIHR and TN were included in I (preoperative pain) (group 1) for evaluation (recurrence, pain, complication).

[†]47th World Congress of Surgery 2017 Basel, Switzerland, 13–17 August 2017

Received: March 28, 2020. Accepted: April 22, 2020

Published by Oxford University Press and JSCR Publishing Ltd. All rights reserved. © The Author(s) 2020.

This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits non-commercial re-use, distribution, and reproduction in any medium, provided the original work is properly cited. For commercial re-use, please contact journals.permissions@oup.com

In II, patients with CPIP (>3 months) after LIHR (group 2) (IO elsewhere) or OIHR (group 3) (IO elsewhere) or LIHR (IO elsewhere) followed by LIHR and/or OIHR for CPIP (group 4) or OIHR (IO elsewhere) followed by LIHR and/or OIHR for CPIP (group 5) were evaluated for recurrence, persistence of CPIP and complications after OIHR with TN and/or mesh removal in our institution.

Neurological investigation of ilioinguinal (IN) and genitofemoral nerve (GN) supported the preliminary diagnosis of nerve entrapment as cause of preoperative pain (I group 1) or CPIP (II groups 2–5).

Patients were instructed on OIHR with TN and mesh removal due to presumed nerve entrapment and on complications (e.g. recurrence, CPIP, hematoma, seroma) or failure of the procedure.

Suture tissue technique (modified Shouldice) and/or special mesh technique (modified Lichtenstein) were applied for primary OIHR. Macroscopically defective nerve branches entrapped in the anterior wall were excised and histologically evaluated. CPIP-associated nerve damage was confirmed by fibrotic epineurium hypertrophy, scarring fibrosis, subepineurial cleft enlargement by myxoid edema and intramural myxoid edematous foci.

During follow-up, complications (seroma, hematoma, temporary or CPIP, inflammation, recurrence) were recorded postoperatively on days 1–3, days 4–30 and thereafter.

In 2007–2017, we performed 396 OIHRs (I, group 1) in 370 patients (51 years mean, 58 years range, 85% male, 15% female) with symptomatic primary inguinal hernia and preoperative pain (98% of cases). There were no intra-operative complications in all groups. In 96% of cases, TN with histological evaluation of excised branches of IN was documented. In total, 93% of resected branches showed signs of chronic nerve injury. There was no CPIP in the follow-up (14 months' mean, 108 months range). However, postoperation (days 1–3) there was temporary somatic pain in 7% of cases, 5% of cases at days 4–30 and 10% thereafter; 11% of patients asked for additional medication for pain relief. We observed only minor, in most cases self-resolving complications, e.g. hematoma ($n = 6$, 1.5%), seroma ($n = 23$, 6%) and inflammatory reactions ($n = 8$, 2%). In three cases (0.7%), a superficial hematoma in the groin had to be drained. The recurrence rate after 14 months was 1%.

In II, group 2, there were 22 cases with OIHR and TN in 20 patients (48 years mean, 44 years range; 5% female, 95% male) who suffered from CPIP pain after LIHR (IO elsewhere). About, 68% of these patients reported to have preoperative pain before IO. All patients had histological evaluation of macroscopically injured/entrapped nerve branches of the IN with histological proof of chronic nerve damage. Temporary somatic groin pain was reported in 27% of patients at days 1–3, 14% of patients at days 4–30 and 32% thereafter. About, 32% of patients asked for additional pain medication. During follow-up (21 months mean; 106 months' range), there was no recurrence of hernia. There were cases (9%) cases of postoperative seroma detected by ultrasound. Seroma, granuloma, muscle and tendon distress, disk prolapse and in one case psychosomatic complaints were causative for the temporary somatic pain. In this group, we observed the only case of CPIP. During LIHR elsewhere, the IN was unrecognized damaged by the trocar perforation. We could not stop the CPIP. The patient had developed a complex regional pain syndrome (CRPS) 10 years after laparoscopic IO.

In II, group 3, 37 cases of CPIP after OIHR (IO elsewhere) were successfully treated by OIHR with TN and mesh removal (50 years mean, 56 range, 13% female, 87% male). About, 49% of patients confirmed preoperative pain before IO. In

97% of cases, histological evaluation could be ordered that demonstrated chronic nerve damage in 92% of histological examinations. Only four cases (11%) of seroma were verified by ultrasound, but no case of hematoma, inflammatory reaction, or CPIP. Temporary somatic pain occurred at days 1–3 in 3% of patients, at days 4–30 in 3%, and 20% thereafter. In 5% of cases, additional pain medication was asked for by patients. During follow-up (22 months' mean, 90 months' range), recurrence was diagnosed in 5% of cases.

In II, group 4 and 5 cases with CPIP after LIHR (IO elsewhere) and further LIHR and/or OIHR (elsewhere) were treated successfully with OIHR, TN and mesh removal. All patients admitted to suffering from preoperative pain prior to IO. All patients had histological evaluation demonstrating chronic nerve damage. In two cases (40%), we discovered seroma by ultrasound; 40% complained of temporary somatic pain postoperatively at days 1–3, 20% at days 4–30, and 40% thereafter. In 40% of cases patients asked for additional pain medication. During follow-up (10 months' mean, 17 months range), no recurrence and no CPIP were diagnosed.

In II, group 5 and 9 cases were successfully treated with OIHR, TN and mesh removal for CPIP after a first OIHR (IO elsewhere) followed by LIHR and/or OIHR repair for CPIP elsewhere. In 33% of cases, preoperative pain before IO was present according to patients. Postoperatively, there was one case of seroma and one case of hematoma without further complication or persistent CPIP. Temporary somatic pain occurred in 11% at days 1–3, 0% at days 4–30 and 0% thereafter. In 11% of cases, patients asked for additional pain medication. During follow-up (6 months' mean, 26 months' range), recurrence has been diagnosed in 11% of cases (Table 1).

DISCUSSION

CPIP with unknown pathogenesis, until recently a largely unrecognized clinical problem, affects up to 62% of patients. It may develop after OIHR and LIHR. However, LIHR has been proposed as first choice for pain prophylaxis in hernia repair. This notion is not supported by our data [5, 6].

The pathogenesis of pain has not been clarified until recently when Wright et al. have discovered that gross enlargement of inguinal nerve with specific changes of compression neuropathy has been associated with increased preoperative pain levels, confirmed in 63% of their patients [7]. This enlargement has been accompanied by fibrosis of the external oblique fascia [8]. Similar signs of compression neuropathy were identified in most patients with preoperative pain and primary OIHR as in patients with CPIP since 2007. Not all risk factors for the development of CPIP may be related to compression neuropathy. Preoperative pain, which has been recorded in most our patients, should be evaluated before taking the decision to operate for inguinal hernia using techniques that take into account the cause and anatomic conditions of pain—otherwise CPIP may be greater in patients who report preoperative pain [9].

Postoperative complications are considered to be a risk factor for CPIP in inguinal hernia repair. We observed low rates of minor complications of seroma (6.8%) and hematoma (1.5%), which caused temporary somatic pain but not CPIP.

There are controversial reports on complications and CPIP. Rates of acute and CPIP may be significantly less after LIHR [10].

The risk for recurrence depends on multifactorial technical- and nontechnical-patient-related factors. Patient-related risk factors for recurrence include female gender, direct inguinal hernia at the first operation, operation for recurrent inguinal

Table 1. Gr (groups 1–5); Op n (number of operations); age (mean); PIO % (Pain before Index Operation in %); OP min (time in op-theatre in minutes); hist % (histology samples in %); NC % (histology of chronic neuropathic compression in %); pOP P I % (postoperative pain days 1–3 in %), pOP P II % (postoperative pain days 4–30 in %); FU (follow-up in month); FU P % (follow-up pain in %); RH % (recurrent hernia in %); and CPIP (chronic postoperative inguinal pain n).

Gr	Op n	Age	PIO %	Op min	Hist %	NC %	pOP P I %	pOP P II %	FU	FU P %	RH %	CPIP n
1	396	51	98	85	96	93	7	5	14	10	1	0
2	22	48	68	92	100	100	27	14	21	32	0	1
3	37	50	49	106	97	92	3	3	22	22	5	0
4	5	55	100	95	100	100	40	20	10	40	0	0
5	9	56	33	109	100	100	11	0	6	0	11	0

hernia and smoking [11]. Complications may occur after OIHR as well as after LIHR [12].

Mesh may have an impact on CPIP and recurrence. In this series, lightweight mesh fixated with sutures was not associated with complications, recurrence or CPIP. Meta-analyses indicated no difference in recurrence and CPIP rates when comparing nonmesh repairs with open- and laparoscopic mesh repairs [13, 14].

We performed color-coded duplex groin examination before and after inguinal hernia repair. We did not observe increased recurrence rates, which may be avoided by the modified operative technique of Lichtenstein closing the hernia defect before we put the mesh in place.

Prophylaxis of CPIP by division of IN or neurectomy has been reported with controversial results [15–17]. Mesh contact of the IN removed from its natural bed may cause CPIP. It has been suggested to avoid neurolysis in Lichtenstein procedures [18]. In this series of primary OIHR, TN of entrapped branches in the anterior abdominal wall of the IN was successfully applied without complication and defect in function. The histological results of compression neuropathy support the need of TN.

We noted when patients complained about pain and asked for additional pain medication. It was a yes or no question—pain or no pain. We did not try to quantify pain. Pain assessment by visual analogue scale (VAS) has been criticized to be inconsistent [19]. Pain and pain medication showed a close association [20]. In this series, the somatic pain stopped when seroma vanished or after intermittent treatment.

Treatment of CPIP remains a complex issue. Prevalence of pain after reoperation may differ [21]. LIHR may avoid pain or may not. Mesh removal and TN may be successful in reducing CPIP [22]. TN for treatment of CPIP may provide good long-term pain relief. However, repeated Lichtenstein and LIHR in the same groin may be associated with high intra- and postoperative complication rates [23]. Guidelines recommend LIHR as first treatment. Persistent CPIP after LIHR or OIHR (IO), which has been followed by further LIHR or OIHR nerve entrapment in the anterior abdominal wall in this series, may be difficult to treat by laparoscopic techniques due to location of nerve entrapment. Clinical, histological results and the patient's response support the decision for OIHR and TN. In most cases, we could demonstrate compression neuropathy in histological samples [24], which confirms the results of Wright et al. as to why patients with compression neuropathy do have pain. Our results of OIHR avoiding CPIP and OIHR abolishing CPIP compare favorably with other expert groups. The incidence of CPIP may be higher in nonexpert groups (18.1–39.4%) compared to expert groups (6.9–11.7%) [25].

This study has some restrictions: it is a retrospective study, not a randomized study and bias may be present. In this study, we did not measure quantity of pain, instead we recorded no pain versus pain/CPIP. CPIP has a variable degree of quality and lacks uniformity in outcome measures. Comparison of the study results, therefore, remains difficult. The advantage is that patients were treated with the same procedure after thorough evaluation of preoperative and persistent CPIP including histological evaluation of most nerve samples. Follow-up in most patients allowed us to investigate the effect of treatment on pain.

CONCLUSION

Preoperative and CPIP analysis is relevant for inguinal hernia treatment. OIHR may be effective in pain prophylaxis and treatment of persistent CPIP after LIHR and OIHR. Compression neuropathy is associated with macroscopic and histological changes in entrapped IN in this study, which is the first and largest histological investigation of nerve entrapment in preoperative and CPIP.

REFERENCES

- Jeroukhimov I, Wisner I, Karasic E, Nesterenko V, Poluksh N, Lavy R, et al. Reduced postoperative chronic pain after tension-free inguinal hernia repair using absorbable sutures: a single-blind randomized clinical trial. *J Am Coll Surg* 2014;**218**:102–7.
- Kehlet H, Jensen TS, Woolf CJ. Persistent postsurgical pain: risk factors and prevention. *Lancet* 2006;**367**:1618–25.
- Nikkolo C, Lepner U. Chronic pain after open inguinal hernia repair. *Postgrad Med* 2016;**128**:69–75.
- Hallén M, Sevonius D, Westerdahl J, Gunnarsson U, Sandblom G. Risk factors for reoperation due to chronic groin postherniorrhaphy pain. *Hernia* 2015;**19**:863–9.
- Öberg S, Andresen K, Klausen TW, Rosenberg J. Chronic pain after mesh versus nonmesh repair of inguinal hernias: a systematic review and a network meta-analysis of randomized controlled trials. *Surgery* 2018;**163**:1151–9.
- Antoniou SA, Köhler G, Antoniou GA, Muysoms FE, Pointner R, Grandrath FA. Meta-analysis of randomized trials comparing nonpenetrating vs mechanical mesh fixation in laparoscopic inguinal hernia repair. *Am J Surg* 2016;**211**:239–49.
- Wright R, Born DE, D'Souza N, Hurd L, Gill R, Wright D. Why do inguinal hernia patients have pain? Histology points to compression neuropathy. *Am J Surg* 2017;**213**:975–82.

8. Wright R, Salisbury T, Landes J. Groin anatomy, preoperative pain, and compression neuropathy in primary inguinal hernia: what really matters. *Am J Surg* 2019;**217**:873–7.
9. Mier N, Helm M, Kastenmeier AS, Gould JC, Goldblatt MI. Preoperative pain in patient with an inguinal hernia predicts long-term quality of life. *Surgery* 2018;**163**:578–81.
10. Bullen NL, Massey LH, Antoniou SA, Smart NJ, Fortelny RH. Open versus laparoscopic mesh repair of primary unilateral uncomplicated inguinal hernia: a systematic review with meta-analysis and trial sequential analysis. *Hernia* 2019;**23**:461–72.
11. Burcharth J, Pommergaard HC, Bisgaard T, Rosenberg J. Patient-related risk factors for recurrence after inguinal hernia repair: a systematic review and meta-analysis of observational studies. *Surg Innov* 2015;**22**:303–17.
12. Kouhia S, Vironen J, Hakala T, Paaajanen H. Open mesh repair for inguinal hernia is safer than laparoscopic repair or open non-mesh repair: a Nationwide registry study of complications. *World J Surg* 2015;**39**:1878–86.
13. Öberg S, Andresen K, Klausen TW, Rosenberg J. Chronic pain after mesh versus nonmesh repair of inguinal hernias: a systematic review and a network meta-analysis of randomized controlled trials. *Surgery* 2018;**163**:1151–9.
14. Lockhart K, Dunn D, Teo S, Ng JY, Dhillon M, Teo E, et al. Mesh versus non-mesh for inguinal and femoral hernia repair. *Cochrane Database Syst Rev* 2018;**9**:CD011517.
15. Wijsmuller AR, van Veen RN, Bosch JL, Lange JF, Kleinrensink GJ, Jeekel J, et al. Nerve management during open hernia repair. *Br J Surg* 2007;**94**:17–22.
16. Hsu W, Chen CS, Lee HC, Liang HH, Kuo LJ, Wei PL, et al. Preservation versus division of ilioinguinal nerve on open mesh repair of inguinal hernia: a meta-analysis of randomized controlled trials. *World J Surg* 2012;**36**:2311–9.
17. Gutlic N, Gutlic A, Petersson U, Rogmark P, Montgomery A. Randomized clinical trial comparing total extraperitoneal with Lichtenstein inguinal hernia repair (TEPLICH trial). *Br J Surg* 2019;**106**:845–55.
18. Reinpold WM, Nehls J, Eggert A. Nerve management and chronic pain after open inguinal hernia repair: a prospective two phase study. *Ann Surg* 2011;**254**:163–8.
19. Molegraaf M, Lange J, Wijsmuller A. Uniformity of chronic pain assessment after inguinal hernia repair: a critical review of the literature. *Eur Surg Res* 2017;**58**:1–19.
20. Holzheimer RG. First results of Lichtenstein hernia repair with Ultrapro-mesh as cost saving procedure–quality control combined with a modified quality of life questionnaire (SF-36) in a series of ambulatory operated patients. *Eur J Med Res* 2004;**9**:323–7.
21. Magnusson N, Gunnarsson U, Nordin P, Smedberg S, Hedberg M, Sandblom G. Reoperation for persistent pain after groin hernia surgery: a population-based study. *Hernia* 2015;**19**:45–51.
22. Zwaans WA, Perquin CW, Loos MJ, Roumen RM, Scheltinga MR. Mesh removal and selective Neurectomy for persistent groin pain following Lichtenstein repair. *World J Surg* 2017;**41**:701–12.
23. Öberg S, Jessen ML, Andresen K, Rothman JV, Rosenberg J. High complication rates during and after repeated Lichtenstein or laparoscopic inguinal hernia repairs in the same groin: a cohort study based on medical records[published online ahead of print, 2019 Dec 9]. *Hernia* 2019;**24**.
24. Wright R, Born DE, D'Souza N, Hurd L, Gill R, Wright D. Pain and compression neuropathy in primary inguinal hernia. *Hernia* 2017;**21**:715–22.
25. Lange JF, Meyer VM, Voropai DA, Keus E, Wijsmuller AR, Ploeg RJ, et al. The role of surgical expertise with regard to chronic postoperative inguinal pain (CPIP) after Lichtenstein correction of inguinal hernia: a systematic review. *Hernia* 2016;**20**:349–56.