

Laparoscopic identification of preperitoneal nerve anatomy in the inguinal area

M. A. Kraus*

Department of Surgery, HCA New Port Richey Hospital, 5637 Marine Parkway, New Port Richey, FL 34656, USA

Received: 9 April 1993/Accepted: 16 July 1993

Abstract. The laparoscopic approach has recently been utilized for inguinal hernia repair. Nerve injuries are now being reported. The femoral branch of the genitofemoral nerve and the lateral cutaneous nerve of the thigh appear most at risk. The purpose of this study was to determine the feasibility of identifying these nerves laparoscopically on either a routine or selective basis. Twenty patients scheduled for laparoscopic inguinal hernia repair were prospectively selected. An attempt was made to identify these nerves so that optimum placement of staples could occur. The femoral branch of the genitofemoral nerve was identified in 19 of 20 patients and the lateral cutaneous nerve of the thigh in 18 of 20 patients. A review of 125 laparoscopic inguinal hernia repairs revealed five nerve injuries (4%). Details are given and recommendations discussed. Knowledge of preperitoneal anatomy and awareness of the location of these nerves should lead to a safer dissection and more accurate application of staples, hopefully decreasing the incidence of nerve injury.

Key words: Laparoscopic – Inguinal – Hernia – Nerve – Anatomy

Symptoms of ilioinguinal, iliohypogastric, and genitofemoral paresthesias and neuralgias following traditional anterior inguinal hernia repair can vary from transient anesthesia of skin below the inguinal incision to severe debilitating postoperative pain [11, 17, 18]. Laparoscopic inguinal hernia repair should reduce the

incidence of these problems, as these nerves are avoided and theoretically at less risk during the laparoscopic preperitoneal approach [2, 6, 7, 10, 14, 16]. Unfortunately, multiple anecdotal and now documented reports are appearing following laparoscopic inguinal hernia repair describing injuries to an entirely new group of nerves not previously encountered during traditional anterior inguinal herniorrhaphy [4, 5, 8, 9, 12, 13, 15]. The lateral cutaneous nerve of the thigh, and to a lesser extent the femoral branch of the genitofemoral nerve, appear to be the nerves most at risk for injury during laparoscopic inguinal hernia repair. It is the purpose of this study to determine the feasibility of laparoscopically identifying these nerves, with the hope that an understanding of their anatomy should decrease the risk of injury.

Materials and methods

Twenty consecutive patients scheduled for laparoscopic inguinal hernia repair were prospectively selected for inclusion in this study. All hernias in this series were repaired by the transabdominal preperitoneal (TAPP) approach. In these patients an attempt was made to identify the femoral branch of the genitofemoral nerve and lateral cutaneous nerve of the thigh. Ten minutes were allotted for this dissection, and if these nerves were not identified in this time period, the search was abandoned and this was recorded as an unsuccessful attempt at nerve identification.

Though neither the femoral branch of the genitofemoral nerve nor the lateral cutaneous nerve of the thigh is usually visible during laparoscopic inguinal hernia repair, once awareness of their customary location and familiarity with dissection techniques developed, these nerves were rapidly and easily identified. These nerves can be found laparoscopically when dissecting lateral to the triangle of doom and below the iliopubic tract [8]. They become visible as the loose areolar and fatty tissue overlying the psoas and iliacus muscles below the iliopubic tract is swept cephalad (Figs. 1 and 2). The femoral branch of the genitofemoral nerve is usually found first, lying directly on the psoas muscle 1–2 cm lateral to the iliac artery. This nerve is not always a single trunk. The lateral cutaneous nerve of the thigh is then found lateral to this lying on the iliacus muscle, beneath its fascial fibers, 1–2 cm medial to the anterior superior iliac spine. This bony landmark can be identified by external palpation

Presented at the annual meeting of the Society of American Gastrointestinal Endoscopic Surgeons (SAGES), Phoenix, Arizona, USA, 2 April 1993

* Present address: 5719 High Street, New Port Richey, FL 34652, USA

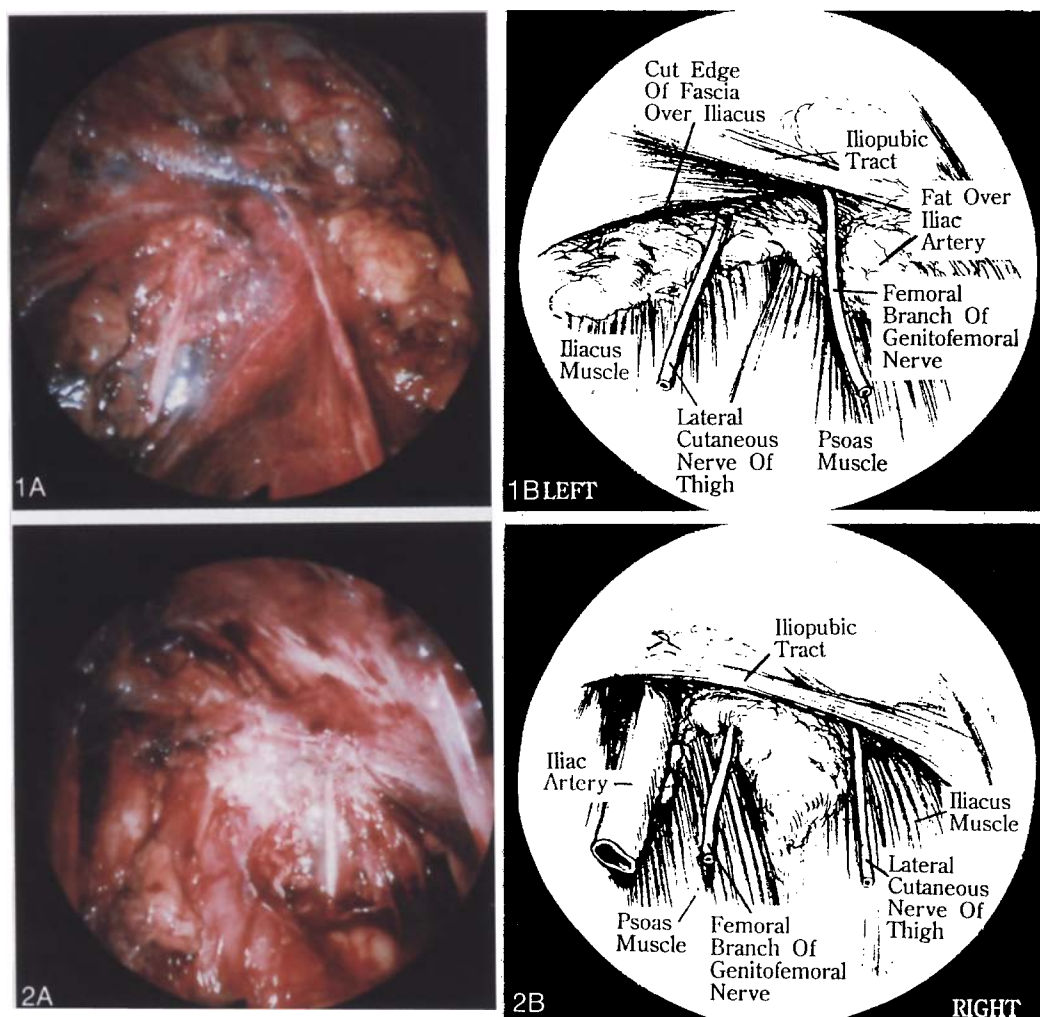


Fig. 1. A and B Left preperitoneal dissection.

Fig. 2. A and B Right preperitoneal dissection.

through the abdominal wall. Unlike the psoas muscle, which does not have a well-formed fascial covering, a discrete fascia overlies the iliacus muscle. Though the lateral cutaneous nerve of the thigh can often be seen through these fibers, it is sometimes necessary to dissect and cut through this fascia to locate the underlying nerve. Both the femoral branch of the genitofemoral nerve and the lateral cutaneous nerve of the thigh usually pass beneath the iliopubic tract and inguinal ligament, but on occasion they may pass directly through them as they course to the thigh.

Results

Prior to initiating this study, cadaver dissections were carried out to gain an understanding of the pertinent preperitoneal anatomy. This was followed by laparoscopic dissections so a technique could be developed for rapid and reproducible identification of these nerves. During the course of this study, the femoral branch of the genitofemoral nerve was identified in 19 of 20 patients in the allotted time. The lateral cutaneous nerve of the thigh was identified in 18 of 20 patients. As

familiarity with the technique improved, these nerves were rapidly and easily identified.

It should be noted that these 20 patients were part of a total series of 125 laparoscopic inguinal hernia repairs. Of these 125 repairs, five nerve injuries have occurred for a 4% injury rate. Interestingly, 4 of these 5 patients were females, and 3 of these were thin, young, and very active. The significance of this is unclear at this time. Four patients had symptoms referable to the lateral cutaneous nerve of the thigh, and one patient had symptoms suggestive of injury to both the femoral branch of the genitofemoral nerve and the lateral cutaneous nerve of the thigh. The first patient is a 35-year-old female who complained postoperatively of numbness in a patch of skin approximately 4 cm in size at the junction of the middle and lower thirds of her anterolateral right thigh. She stated that when she flexed and then extended her right hip, she developed a shooting pain down the lateral thigh into the area of numbness. She was very active and during

exercise and bike riding her symptoms were exacerbated. Though these were only of moderate severity, her symptoms lasted 9 months, ultimately totally resolving without sequelae. The second patient is a 29-year-old female who underwent laparoscopic left inguinal herniorrhaphy. In the immediate postoperative period she complained of pain in her leg associated with a trigger point a couple of centimeters lateral to the femoral artery. This pain was initially quite severe and incapacitating, radiating down her lateral thigh. With a course of observation and Ibuprofen her symptoms totally resolved in 8 weeks. These first two injuries were the most severe, the first lasting the longest period of time and the second being the most incapacitating. Upon review of the video tapes, these two injuries probably occurred when a staple was placed in the lower outer corner of the mesh where it draped below the lateral iliopubic tract and over the underlying iliacus muscle and lateral cutaneous nerve of the thigh. This location is too cephalad for stapling and is now known to be a danger area [8]. Staples should not be placed below the iliopubic tract. These two injuries occurred prior to the onset of this study, before an understanding of the anatomy was gained, and in fact were the stimulus for this study. Two other injuries occurred in later patients while attempting to locate the lateral cutaneous nerve of the thigh. The third patient is a 19-year-old female who had complaints of intermittent numbness in the anterior aspect of her upper left thigh and patchy numbness over her left femoral triangle following a laparoscopic left inguinal hernia repair. These symptoms were quite minor and totally resolved over 4 weeks. The fourth patient is a 54-year-old male who underwent laparoscopic repair of bilateral inguinal hernias and postoperatively developed some minor intermittent shooting pain in the lateral aspect of his left thigh. These symptoms completely resolved over a period of several months. Upon review of the video tape, injuries in the third and fourth patient were felt to be due to direct nerve trauma when too vigorous a dissection was carried out laterally and below the iliopubic tract. This is not only a danger area for stapling; caution must also be exercised if dissection is carried out here. The third patient probably had dissection trauma to both the femoral branch of the genitofemoral nerve and the lateral cutaneous nerve of the thigh, while the fourth patient had injury to only the lateral cutaneous nerve of the thigh. The fifth and final injury occurred in a 77-year-old female who developed some minor paresthesias in the lower lateral thigh just above her knee following a laparoscopic right inguinal hernia repair. She described the symptoms as a burning pain and they resolved over a period of about 6 weeks. Review of the video tape revealed that the injury appeared to have occurred when a fine filamentous structure passing directly through the lateral iliopubic tract was cut. This probably was a minor branch of the lateral cutaneous nerve of the thigh. These last three patients have had only minor transient symptoms, resolving in 4–6 weeks. From an analysis of these five patients, it seems that injuries due to staple placement have

a more severe and protracted course, while injuries due to dissection trauma are more minor and transient.

After the initial 20 patients in this study, the anatomic location of these nerves was verified in an additional 25–30 patients. By this time it had become apparent that a technique which included awareness of nerve location and avoidance of dissection and stapling in known danger areas would be beneficial in helping to decrease the likelihood of nerve injury. Utilization of this approach has allowed the flexibility of performing actual dissection and nerve exposure in only selected cases. Since this approach has been followed, no nerve injuries have occurred in the last 70 hernia repairs. Based on these results, it seems that this combined approach of awareness of nerve location and selective exposure only when indicated would be safer than routine nerve exposure which occasionally necessitated vigorous dissection and could cause injury in its own right.

Discussion

Although ilioinguinal, iliohypogastric, and genitofemoral nerve entrapment syndromes manifested by varying degrees of hypesthesia, paresthesia, and anesthesia in the inguinal region following inguinal hernia repair are customarily minor, they may occasionally result in prolonged disabling symptoms often resistant to therapy [1, 11, 17–19]. A variety of treatments have been attempted, including steroid injection, pain medication, nerve stimulation, and reexploration, with varying degrees of success. These patients can develop drug dependency, family problems, and occupational incapacitation due to their disability. To minimize the risk of these complications, it is often routine during traditional anterior inguinal hernia repair to identify these nerves so as to avoid injury.

Fortunately, injuries to these nerves do in fact appear to be decreased following laparoscopic inguinal hernia repair, but injuries to the lateral cutaneous nerve of the thigh and to a lesser degree the femoral branch of the genitofemoral nerve are now being reported in their place. Injuries to the lateral cutaneous nerve of the thigh and the femoral branch of the genitofemoral nerve are quite rare during traditional anterior inguinal hernia repair and seem to be unique to laparoscopic inguinal hernia repair. One report estimates that “some type of nerve trauma” is occurring in 10–15% of laparoscopic inguinal hernia repair cases, mainly to the femoral branch of the genitofemoral nerve and the lateral cutaneous nerve of the thigh [13].

Whether selective or routine identification of the femoral branch of the genitofemoral nerve and lateral cutaneous nerve of the thigh will become necessary during laparoscopic inguinal hernia repair awaits the accumulation of further data, but at the very minimum, appreciation of the anatomy and awareness of the location of these nerves appear essential.

The specific mechanism of nerve injury during lap-

aroscopic inguinal hernia repair is unknown, but presumably is due to either nerve trauma during dissection or direct injury secondary to staple placement. This has been previously suggested [8], and following a retrospective review of these video tapes, appears compatible with four of five injuries seen in this series, excluding the one patient who probably had transection of a branch of the lateral femoral cutaneous nerve as it passed laterally through the iliopubic tract.

As shown, the femoral branch of the genitofemoral nerve and lateral cutaneous nerve of the thigh can usually easily be identified during laparoscopic inguinal hernia repair. It is premature at this time to advocate routine exposure of these nerves, as this appears to carry its own risks as evidenced by two of the injuries in this series. If a high incidence of injury becomes apparent in the future as more data become available, consideration may need to be given to selective or routine exposure of these nerves. Knowledge of the anatomic location of the femoral branch of the genitofemoral nerve and the lateral cutaneous nerve of the thigh with avoidance of known danger areas seems the prudent course at this time, reserving selective exposure for specific patients on a case-by-case basis. This approach hopefully should lead to safer dissection, more optimum staple placement, and ultimately a decrease in the incidence of injury to these nerves.

References

1. Condon RE, Nyhus LM (1989) Complications of hernias. In: Nyhus LM, Condon RE (eds) *Hernia*. JB Lippincott, Philadelphia, pp 266-269
2. Corbitt JD (1991) Laparoscopic herniorrhaphy. *Surg Laparosc Endosc* 1: 23-25
3. Corbitt JD (1993) Laparoscopic herniorrhaphy. In: Reddick EJ, Saye WB, Corbitt JD (eds) *Atlas of laparoscopic surgery*. Raven Press, New York, p 108
4. Fitzgibbons RJ Jr (1993) 3: Endosurgical management of hernia (video). *Insights: endosurgery for the 90's*. Ethicon
5. Fitzgibbons RJ Jr, Annibali R, Litke B, Filipi C, Salerno A (1993) A multicentered clinical trial on laparoscopic inguinal hernia repair: preliminary results. *SAGES Scientific Session 1: Abstract 118*
6. Ger R, Monroe K, Duvivier R, Mishrick A (1990) Management of indirect inguinal hernias by laparoscopic closure of the neck of the sac. *Am J Surg* 159: 370-373
7. Ger R (1991) The laparoscopic management of groin hernias. *Contemp Surg* 39: 15-19
8. Kraus MA (1993) Nerve injury during laparoscopic inguinal herniorrhaphy. *Surg Laparosc Endosc* 3: 342-345
9. MacFadyen Jr BV, Arregui ME, Corbitt Jr JD, Filipi CJ, Fitzgibbons Jr RJ, Franklin ME, McKernan JB, Olsen DO, Phillips EH, Rosenthal D, Schultz LS, Sewell RW, Smoot RT, Spaw AT, Toy FK, Waddell RL, Zucker KA (1993) Complications of laparoscopic herniorrhaphy. *Surg Endosc* 7: 155-158
10. McKernan JB, Laws HL (1992) Laparoscopic preperitoneal prosthetic repair of inguinal hernias. *Surgical Rounds* 597-610
11. Moosman DA, Oelrich TM (1977) Prevention of accidental trauma to the ilioinguinal nerve during inguinal herniorrhaphy. *Am J Surg* 133: 146-148
12. Phillips EH, Carol BJ (1993) Laparoscopic inguinal hernia repair. *Gastrointest Endosc Clin N Am* 3: 297
13. Rosser B (1992) Hernia repair: common complications and how to avoid them. *Laparosc In Focus* 1 8: 2
14. Salerno GM, Fitzgibbons RJ, Filipi CJ (1991) Laparoscopic inguinal hernia repair. In: Zucker KA (ed) *Surgical laparoscopy*. Quality Medical Publishing, St Louis, pp 281-293
15. Seid A (1993) Significance of groin nerve anatomy for laparoscopic hernia repair. *SAGES Scientific Session I: Abstract 53*
16. Shultz L, Graber J, Pietrafitta J, Hickcock D (1990) Laser laparoscopic herniorrhaphy: a clinical trial preliminary results. *J Laparoendosc Surg* 1: 41-45
17. Starling JR, Harms BA, Schroeder ME, Eichman PL (1987) Diagnosis and treatment of genitofemoral and ilioinguinal entrapment neuralgia. *Surgery* 102: 581-586
18. Starling JR, Harms BA (1989) Diagnosis and treatment of genitofemoral and ilioinguinal neuralgia. *World J Surg* 13: 586-591
19. Stulz P, Pfeiffer KM (1982) Peripheral nerve injuries resulting from common surgical procedures in the lower portion of the abdomen. *Arch Surg* 117: 324-327

Discussion

Dr. Arregui: Thank you very much, Dr. Kraus. And I think the message has come across that we do need to learn the anatomy.

Is it all right to put staples on the iliopubic tract, or should we avoid that? In one of your comments, you mentioned that the nerves can penetrate the iliopubic tract.

Dr. Kraus: In some cases, they actually go through the iliopubic tract and don't pass beneath it. So I think that if you feel obligated to place a clip in the lower outer corner and you need to secure it to the iliopubic tract, I think that you need to lift the iliopubic tract up and just very superficially place a clip here. But I don't think that you should force the clip in deep.

Dr. Marks: Is there any future role for other fixation devices, such as fibrin glue, something that could decrease the entrapment problems?

Dr. Kraus: I don't really know the answer to that, but that's probably a reasonable thought.

But I also think that if you're aware of where these nerves are you'll probably avoid this damage. I've had five nerve injuries in about 150 patients, which is about 4 percent. But these nerve injuries were all early before I learned where these nerves were.

Once I learned where they were, I didn't get any dissection injuries or clip injuries. In my last 75 patients, I haven't had any nerve injuries.

Dr. Pomerantz: When you expose a nerve this nicely and put the mesh directly over it, the mesh causes intense fibrosis in due course.

Do you have any follow-up on these patients to know if, not the staple, but the fibrosis caused the entrapment problem?

Dr. Kraus: I'm not aware that any of these injuries have shown themselves long term. I think most of these injuries show themselves right away.

Dr. Arregui: Will you be giving us a follow-up on these patients that you've exposed?

Dr. Kraus: Absolutely. Interestingly, I've had two in-

juries from clips, which were my first two injuries. And they were actually my most severe injuries, and that's actually what made me initiate this study.

And then I did dissections of the nerves in about 50 or 60 patients. In these patients I had two very transient lateral femoral cutaneous nerve injuries where I dissected out the nerves. And then in the last 75 patients, where I did no dissection, I had no injuries at all.

Dr. Duncan: I noticed that when you identify the ilio-

pubic tract, you also dissect below it. Do you recommend a routine dissection in that area, or do you recommend just identifying the iliopubic tract and then not going below that area?

Dr. Kraus: I think that's a good point. I'm not at all advocating dissecting below the iliopubic tract. This was sort of done for tutorial purposes. I think that you should keep away from the area below the iliopubic tract.