Chirurgia (2011) 106: 599-603
Nr. 5, Septembrie - Octombrie

A short postgraduate anatomy course may improve the junior surgical residents' anatomy knowledge for the nerves of the inguinal region

Z. Ergül[1], H. Kulaçoğlu[1], T. Sen[2], A.F. Esmer[2], M. Güller[1], G. Güneri[1], A. Elhan[2]

[1]Department of Surgery, Diskapi Yildirim Beyazit Teaching and Research Hospital, Ankara, Turkey
[2]Department of Anatomy, Ankara University Medical Faculty, Ankara, Turkey

"Whoever learns anatomy only from books should operate on books only" (Schein, 2004)

Rezumat

Un curs postuniversitar scurt de anatomie poate îmbunătăți cunoștințele de anatomie ale tinerilor rezidenți de chirurgie despre nervii regiunii inghinale

Premizele și scopul lucrării: Tratamentul chirurgical al herniei inghinale este una dintre cele mai răspândite operații în programa de pregătire a tinerilor rezidenți în chirurgie. Cursurile recapitulative scurte pot îmbunătăți cunoștiințele de anatomie ale tinerilor rezidenți și au drept consecință rezultatele chirurgicale mai bune. Scopul nostru a fost să investigăm efectul unor cursuri scurte de competențe anatomice în timpul unor operații pentru hernie inghinală.
Metodă: În timpul primelor 25 de intervenții chirurgicale pentru hernie inghinală, la doi tineri rezidenți li s-a cerut să identifice ramurile iliohipogastrică, ilioinghinală și genitală a nervului genitofemural. Apoi, cei doi rezidenți au urmat un scurt curs recapitulativ susținut de anatomiști. După aceea, rezidentii au participat din nou la un test de anatomie in-vivo. Aceeași parametri au fost înregistrați la următoarele 25 de intervenții chirurgicale pentru hernie inghinală. Pe lângă înregistrarea identificării nervilor, au fost notate caracteristicile cazurilor operate [indexul de masă corporală (BMI $\leq$ 25 vs. $>$25), tipul de hernie (indirectă vs. directă) și tipul de anestezie administrată (generală sau regională vs. locală)].
Rezultate: Participarea la cursurile de anatomie are un impact clar în rata corectă de identificare a nervilor iliohipogastric și ilioinghinal. Rata crește de la 70% la 90% sau mai mult. Rata de identificare corectă a tuturor celor trei nervi a crescut semnificativ de la 16 la 52% după instruirea în anatomie (p=0,006). Toți cei trei nervi au fost identificați cu o rată mai mare de succes după cursurile de anatomie. Rata de succes în identificarea ramurii genitale a nervului genitofemural a crescut de 4 ori.
Concluzii: Cursurile scurte de anatomie pentru tinerii rezidenți de chirurgie, pe o tematică specifică și susținute de anatomiști pot fi eficiente în timpul pregătirii postuniversitare. Beneficiile obținute în acest studiu pentru nervii regiunii inghinale pot fi extinse la structuri anatomice mai importante, cum ar fi nervul laringeal recurent în tiroidectomie sau chiar subiecte anatomice mai complexe.

Cuvinte cheie: hernie inghinală, nerv ilioinghinal, nerv iliohipograstric, nerv genitofemural, anatomie generală, disecție, anatomie chirurgicală, pregătire postuniversitară, rezidențiat în chirurgie

Corresponding author: Dr. Hakan Kulacoglu
Department of Surgery, Diskapi Yildirim Beyazit Teaching and Research Hospital, Bahcelievler, 1.cadde, 109/5, 06490, Ankara, Turkey
E-mail: hakankulacoglu@hotmail.com

Abstract
Background and Aim: Inguinal hernia repair is one of the most common operations in a junior surgical resident's postgraduate

training. Short recall courses can improve junior residents' anatomy knowledge and results in better surgical outcomes. We aimed to investigate the effect of a short course on anatomical competency during inguinal hernia repairs.
Methods: During the first 25 inguinal hernia repairs, two junior residents were asked to identify iliohypogastric, ilioinguinal, and genital branch of genitofemoral nerves. Then, the residents were given a short recall course by anatomists. Afterwards, the participants were taken into an in-vivo anatomy test again. The same parameters were recorded in another 25 inguinal hernia repairs. In addition to the nerve identification records, case characteristics [body mass index (BMI $\leq$ 25 vs. $>$25), hernia type (indirect vs. direct), and anesthesia used (general or regional vs. local)] were recorded.
Results: Anatomy education had a clear impact on the correct identification rates for the iliohypogastric and ilioinguinal nerves. The rates increased from 70% to 90% and above. Correct identification rate for the three nerves together significantly increased from 16 to 52% following anatomy education ($P = 0.006$). All three nerves were identified with significantly higher success rates after anatomy education. The increase in the success rate for identification of the genital branch of genitofemoral nerve was 4-fold.
Conclusions: Short anatomy courses in specific subjects for junior surgical residents given by formal anatomists may be effective during postgraduate education. The benefit obtained in the present study for the inguinal region nerves may be expanded to more important anatomical structures, such as the recurrent laryngeal nerve in a thyroidectomy, or more complex subjects.

Key words: Inguinal hernia, ilioinguinal nerve, iliohypogastric nerve, genitofemoral, gross anatomy, dissection, surgical anatomy, postgraduate education, surgery resident education

Introduction

Inguinal hernia repair is one of the most common operations in a junior surgical resident's postgraduate training. It is considered less risky than other procedures. However, inguinal anatomy is quite complex, and many young surgeons routinely perform hernia repairs without complete knowledge of the anatomy of the inguinal region.

Newer hernia repair techniques, especially those using mesh, have reduced recurrence rates after inguinal herniorrhaphies (1,2), but regional nerve-related complications have increased (3). Hernia repairs may cause chronic pain if nerves are injured or compressed during repair. The incidence of chronic pain after inguinal hernia repairs have been reported as high as 50% (4).

Decades after Dr. Francis C. Usher (1908–1980), a famous herniologist and a pioneer of practical prosthetic polypropylene mesh (5), said "numbness is better than neuropathy", some surgeons have started to resect the nerves to avoid postoperative chronic pain (6-8). Nevertheless, as Prof. Hermann M. Biggs (1859–1923), a former New York City health commissioner said "The human body is the only machine for which there are no spare parts" (9); nerve resections may cause annoying and sometimes irreversible loss of skin sensation. In addition, the value of nerve identification and preservation during inguinal hernia repair has been shown in clinical and experimental studies (10-12). Also, Wijsmuller et al.'s recent systematic review stated that the regional nerves should probably be identified during open hernia repair (13).

In our routine surgical training curriculum, junior residents are taught inguinal anatomy, including the anatomy of the regional nerves, by senior residents during inguinal surgeries. They also read anatomy books before participating in the operations. A study carried out in 2004 during the 90th Annual Clinical Congress of American College of Surgeons and in Department of Surgery at Feinberg School of Medicine, Northwestern University in Chicago, IL, has revealed that the most frequently used resources for operating room preparation are major surgical textbooks and advice from senior colleagues (14). The same study reported that more than 75% of seniors felt that junior residents were still lacking in sufficient anatomical knowledge after preparation.

In non-academic teaching hospitals, where formal anatomy departments do not exist, practical studies are beyond the curriculum. Recently, we established a new program for inguinal region anatomy together with the anatomy department of a medical school in our city. This study aimed to investigate the effect of this new anatomy education program on the anatomical knowledge of the junior residents during inguinal hernia repairs.

Material and Method

Two junior residents in the first year of their postgraduate education were involved in the study. Each one had previously participated in 10 inguinal hernia repairs. They both were given routine operating tips on anatomy by the seniors. During the first 25 repairs in the study period, the most senior surgeon asked the residents to identify the iliohypogastric nerve, the ilioinguinal nerve, and the genital branch of the genitofemoral nerve in-vivo with a fine pick-up. This monitoring surgeon, who was very experienced and had a specific interest in the inguinal region, recorded the following parameters:

- Could the resident point out the nerves? (correctly or incorrectly);
- The time (in seconds) it took the resident to point out the nerves;
- Were the identifications correct?

Afterward, these two junior residents attended a 1-hour lecture by an anatomy professor about the inguinal region and specific regional nerves, including their variations. Then, two different anatomists showed the detailed anatomy of the inguinal region by using three different formalin fixed cadavers. In this session, all of the important anatomic structures, including the iliohypogastric nerve, the ilioinguinal nerve, the genital branch of genitofemoral nerve, muscles of

the anterior and lateral abdominal wall, the deep and superficial inguinal rings, vessels of the area, and the spermatic cord, were demonstrated. After the anatomy lecture and practicum, the two participants were taken into an in-vivo surgical anatomy evaluation again. The same three parameters were recorded in another 25 inguinal hernia repairs.

In addition to the nerve identification records, case characteristics such as patient body mass index (BMI ≤25 vs. >25), hernia type (indirect vs. direct), and anesthesia used (general or regional vs. local) were recorded. The main factors "correct nerve identification and pointing time" before and after the anatomy education and the other possible contributory parameters were compared by using the chi-square and Student's t test as well as the Mann-Whitney test. SPSS for Windows version 17.0 was used for statistical analysis.

Results

In the first part of the study (before the anatomy education), the ilioinguinal nerve was pointed out in all cases. The residents could point out the iliohypogastric nerve 96% of cases, while the rate of the genital branch of genitofemoral nerve was 88%. Anatomy lecture and cadaver dissection practice did not show any significant effect on this parameter *(Table 1)*.

The residents pointed out the iliohypogastric and ilioinguinal nerves significantly faster after anatomy education. However, this was not the case for the genital branch of genitofemoral nerve *(Table 2)*.

Anatomy education had a clear impact on the correct identification rates for the iliohypogastric and ilioinguinal nerves. The rates increased from 70% to 90% and above. Nevertheless, no change was seen in the identification of the genital branch of genitofemoral nerve *(Table 3)*. However, correct identification rate for the three nerves together (triple-correct) significantly increased from 16 to 52% following anatomy education (p=0.006).

The most striking finding was seen when the "correct identification rate within 10 seconds" criterion was established. All three nerves were identified with significantly higher success rates after anatomy education. The increase in the success rate for identification of the genital branch of genitofemoral nerve was 4-fold *(Table 4)*.

On the other hand, no difference was observed between the two residents' records. BMI, hernia type and anesthesia technique also showed no significant effects on nerve identification. However, BMI greater than 25 caused somewhat lower rates of correct identification of the genital branch of the genitofemoral nerve (56% vs. 30%; p=0.07).

Table 1. *Residents' nerve pointing rates as percent (%) before and after anatomy course*

	Before	After	p
Iliohypogastric nerve	96	100	ns
Ilioinguinal nerve	100	100	ns
Genital branch of genitofemoral nerve	88	84	ns

Table 2. *Nerve pointing time in seconds before and after anatomy course*

	Before	After	p
Iliohypogastric nerve	10.7 (±11.3)	5.2 (±6.1)	0.014
Ilioinguinal nerve	11.5 (±10.4)	8.1 (±9.8)	0.002
Genital branch of genitofemoral nerve	19.3 (±12.7)	15.2 (±11.4)	ns

Table 3. *Correct nerve identification rates as percent (%) before and after anatomy course*

	Before	After	p
Iliohypogastric nerve	79	96	0.08
Ilioinguinal nerve	72	92	0.07
Genital branch of genitofemoral nerve	39	52	ns

Table 4. *The percentages for correct nerve identification within 10 seconds before and after anatomy course*

	Before	After	p
Iliohypogastric nerve	60	88	0.03
Ilioinguinal nerve	36	76	0.005
Genital branch of genitofemoral nerve	8	32	0.037

Discussion

In the preface of their classical book, Skandalakis and colleagues state "Failure to achieve desired results is often caused by an inadequate knowledge of normal anatomy and its possible variations. For this reason, we have sometimes described in detail certain anatomical areas not well covered in standard [anatomy] textbooks" (15).

Surgical anatomy books have contributed greatly to surgical training (15-17). Most residents read the relevant chapters of these books before participating in the operations. Seniors also supply them with additional information and practical tips during surgery. However, complex anatomic regions like the inguinal canal can still cause confusion in certain cases.

The importance of anatomical training for doctors in postgraduate education began in medical literature as early as the 1950s (18). Lachman wrote that 83% of doctors and 91% of surgeons felt they had needed more teaching in anatomy (19). The overwhelming majority of them wanted to receive their education in anatomy from anatomists and clinicians combined. Anatomists agreed that the best time for training of residents is in the second year of residency.

Anatomy education in medical school has been evaluated in some recent papers. Smith and Mathias'

exploratory case study revealed that 68.3% of the alumni were concerned that there was still a substantial amount of anatomy that they did not know (20). Nevertheless, the majority felt that if they did forget something, it came back easily with a small amount of study. In a questionnaire among newly qualified doctors, 47% of the respondents who indicated an intention to pursue a surgical career judged that they had received sufficient anatomical training (21).

Gupta and colleagues reported that junior surgical residents' general anatomical knowledge is no better than that of physicians and emergency medicine doctors (18). However, their marks significantly improved when they became senior residents. This improvement is probably related to the benefit from years of clinical experience, where daily application of anatomical concepts in the workplace facilitates factual recall.

Pabst and Rothkötter based on a questionnaire distributed among doctors at the end of their residency reported that 99% of all specialists, not only surgeons, answered that gross anatomy was fundamental or necessary; therefore, special anatomy courses related to every specialty should be given at the beginning of postgraduate training (22).

Cottam in a survey among the directors of residency programs in 1999 also reported that 99% of the directors of surgical residency programs thought that gross anatomy is very important for the residency program. Gross anatomy was also considered more important than all other basic sciences (23). Strikingly, only 14% of surgical directors found new residents' anatomical knowledge adequate, while 62% said that newcomers need a refresher. When asked if they used formally trained gross anatomists to give additional anatomical training, 94% said that they did not. Interestingly, a few programs cited the lack of availability of anatomists.

In fact, every single medical school probably has an appropriate and sufficient anatomy course for the students. However, detailed anatomical knowledge is hard to learn and easily fades away over time. Residents in different specialties should focus on the relevant anatomy specific to their field, study to recall the necessary knowledge and learn more as needed. Short anatomy courses early in the residency program can help residents succeed. In general surgery, these spot courses can be directed to several specific areas, such as the thyroid-parathyroid, the liver, the anal region, and the inguinal region. Similarly, Minor and Poenaru recommended that efforts to improve the teaching process should focus on the provision of formal teaching instruction early in residency (24).

Non-academic teaching hospitals in Turkey do not have formal anatomy departments or anatomy courses. These hospitals have postgraduate programs but do not teach medical students. This simply reflects the lack of several basic scientific disciplines, including anatomy or physiology. In fact, many surgical departments in training hospitals affiliated with medical schools do not have a close relationship with their anatomy departments.

The concern about regional nerves increased after observing an unacceptable rate for post-herniorrhaphy chronic pain. This has caused surgeons to be more interested in nerve anatomy. Prof. Amid of the Lichtenstein Hernia Institute recommends that a surgeon should treat the regional nerves during an inguinal hernia repair similar to the recurrent laryngeal nerve during a thyroidectomy (Personal communication and meeting speeches). Wijsmuller et al have shown that peroperative identification of all inguinal nerves is possible (25). Senior surgeons surely teach their juniors about nerve anatomy during inguinal hernia repairs. However, anatomists may be able to add additional information.

Selected centers teach their residents with virtual anatomy simulators with the aid of computers and modern radiological techniques (26-28). Dobson and colleagues used this kind of education technique for anorectal and pelvic floor anatomy on third and fourth year residents Dobson et al., 2003. A standard examination was administered before and after this education. The residents increased their score from 21 to 41% after the simulator course. An earlier comparative anatomy education study on pelvic anatomy was completed by Gordinier and colleagues (29). They divided first and second year residents into classical teaching and cadaver dissection groups. The cadaver dissection group scored almost 50% higher on post-course written examination than the controls.

To the best of our knowledge, there has been no study specifically measuring the effects of a short anatomy course on operating room practice. We recorded that correct nerve identification rates were less than 80% for the iliohypogastric and ilioinguinal nerves and less than 40% for the genital branch of genitofemoral nerve in spite of workplace teaching by the seniors. We observed that even the short anatomy course described above could improve these results. The correct identification rates for the iliohypogastric and ilio-inguinal nerves improved after the course. However, the genital branch of genitofemoral nerve remained a difficult subject for the residents in spite of education. Lange et al. previously reported the same difficulty (30). This was a somewhat expected result because the genital branch of genitofemoral nerve is a thinner neural structure than the other two regional nerves, and it is one of the constituents of the spermatic cord, therefore its identifications may be difficult in fatty patients. The finding that correct identification of the genital branch of genitofemoral nerve was higher in patients with a BMI less than 25 supported this fact. In patients with a BMI greater than 25, there was a lower rate of correct identification.

In conclusion, short anatomy courses in specific subjects for junior surgical residents given by formal anatomists may be effective during postgraduate education. The benefit obtained in the present study for the inguinal region nerves may be expanded to more important anatomical structures, such as the recurrent laryngeal nerve of a thyroidectomy, or more complex subjects.

References

1. Kurzer M, Belsham PA, Kark AE. The Lichtenstein repair for groin hernias. Surg Clin North Am. 2003;83(5):1099–117.
2. Chastan P. Tension-free inguinal hernia repair: A retrospective study of 3000 cases in one center. Int Surg. 2005,90(1):48–52.

3. Yunis J. Critical issues in groin hernia management. Surg Technol Int. 2009;18:119–24.
4. Paily A, Thornton M. Chronic pain following a Lichtenstein inguinal hernia repair: A clinical and legal dilemma. ANZ J Surg. 2009;79:517-20.
5. Read RC. Francis C. Usher, herniologist of the twentieth century. Hernia 1999;3(3):167-71.
6. Dittrick GW, Ridl K, Kuhn JA, McCarty TM. Routine ilioinguinal nerve excision in inguinal hernia repairs. Am J Surg. 2004;88:736-40.
7. Karakayali F, Oksuz E, Turk E, Pekmez M, Karabulut Z, Yilmaz T, et al. Effectiveness of multiple neurectomies to prevent chronic groin pain after tension-free hernia repair. Int Surg. 2010;95(1):40-8.
8. Mui WL, Ng CS, Fung TM, Cheung FK, Wong CM, Ma TH, et al. Prophylactic ilioinguinal neurectomy in open inguinal hernia repair: A double-blind randomized controlled trial. Ann Surg. 2006;244(1):27–33.
9. Schein M. Aphorisms and Quotations for the Surgeon. First edition. tfm Publishing Ltd (Shropshire, UK) 2004
10. Alfieri S, Rotondi F, Di Giorgio A, Fumagalli U, Salzano A, Di Miceli D, et al. 2006. Influence of preservation versus division of ilioinguinal, iliohypogastric, and genital nerves during open mesh herniorrhaphy: prospective multicentric study of chronic pain. Ann Surg. 2006;243(4):553-8.
11. Amid PK, Hiatt JR. New understanding of the causes and surgical treatment of postherniorrhaphy inguinodynia and orchalgia. J Am Coll Surg. 2007;205(2):381-5.
12. Yavuz A, Kulacoglu H, Olcucuoglu E, Hucumenoglu S, Ensari C, Ergul Z, et al. The Faith of Ilioinguinal Nerve After Preserving, Cutting, or Ligating It: An Experimental Study of Mesh Placement on Inguinal Floor. J Surg Res. 2010 doi: 10.1016/j.jss.2010.07.016
13. Wijsmuller AR, Lange JF, Kleinrensink GJ, van Geldere D, Simons MP, Huygen FJ, et al. Nerve-identifying inguinal hernia repair: a surgical anatomical study. World J Surg. 2007; 31(2):414-20.
14. Pugh CM, DaRosa DA, Glenn D, Bell RH Jr. A comparison of faculty and resident perception of resident learning needs in the operating room. J Surg Educ. 2007;64(5):250-5.
15. Skandalakis JE, Gray SW, Rowe JS Jr. Anatomical Complications in General Surgery. First Edition. McGraw-Hill (New York) 1987.
16. Anson BJ, McVay CB. Surgical Anatomy. Sixth Edition. W.B. Saunders Co. (Philadelphia), 1984.
17. Gray H. Gray's Anatomy: The Anatomical Basis of Clinical Practice. Fourtieth Edition. Churchill Livingstone (Philadelphia), 2009.
18. Gupta Y, Morgan M, Singh A, Ellis H. Junior doctors' knowledge of applied clinical anatomy. Clin Anat. 2008;21(4):334-8.
19. Lachman E. Resident and postgraduate training in anatomy. J Med Educ. 1956;31(11):751-6.
20. Smith CF, Mathias HS. What impact does anatomy education have on clinical practice? Clin Anat. 2010 DOI: 10.1002/ ca.21065
21. Fitzgerald JE, White MJ, Tang SW, Maxwell-Armstrong CA, James DK. Are we teaching sufficient anatomy at medical school? The opinions of newly qualified doctors. Clin Anat. 2008;21(7):718-24.
22. Pabst R, Rothkötter HJ. Retrospective evaluation of undergraduate medical education by doctors at the end of their residency time in hospitals: Consequences for the anatomical curriculum. Anat Rec. 1997;249(4):431-4.
23. Cottam WW. Adequacy of medical school gross anatomy education as perceived by certain postgraduate residency programs and anatomy course directors. Clin Anat. 1999;12(1):55-65.
24. Minor S, Poenaru D. The in-house education of clinical clerks in surgery and the role of housestaff. Am J Surg. 2002;184(5):471-5.
25. 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(1):17-22.
26. Dobson HD, Pearl RK, Orsay CP, Rasmussen M, Evenhouse R, Ai Z, et al. Virtual reality: New method of teaching anorectal and pelvic floor anatomy. Dis Colon Rectum. 2003;46(3):349-52.
27. Hassinger JP, Dozois EJ, Holubar SD, Camp JC, Farley DR, Fidler JL, et al. Virtual pelvic anatomy simulator: A pilot study of usability and perceived effectiveness. J Surg Res. 2010;161(1):23-7.
28. Sergovich A, Johnson M, Wilson TD. Explorable three-dimensional digital model of the female pelvis, pelvic contents, and perineum for anatomical education. Anat Sci Educ. 2010; 3(3):127-33.
29. Gordinier ME, Granai CO, Jackson ND, Metheny WP. The effects of a course in cadaver dissection on resident knowledge of pelvic anatomy: An experimental study. Obstet Gynecol 1995;86(1):137-9.
30. Lange JF, Wijsmuller AR, van Geldere D, Simons MP, Swart R, Oomen J, et al. Feasibility study of three-nerve-recognizing Lichtenstein procedure for inguinal hernia. Br J Surg. 2009; 96(10):1210-4.