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ORIGINAL CONTRIBUTIONS

Training Courses in Laparoscopic Bariatric Surgery on Cadaver Thiel: Results of a Satisfaction Survey on Students and Professors

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Abstract

Introduction For the acquisition of skills in laparoscopic surgery, practices in experimental labs are gaining increasing relevance. Activities in experimental labs include Pelvitrainers, virtual reality simulators, and experimental animals (frequently pigs). However, the best model for surgical formation is the performance of interventions on cadavers. The Thiel method gives the body elasticity, which allows the performance of laparoscopic procedures.

Methods An observational prospective study was performed on surgeons attending to two courses of laparoscopic bariatric surgery on cadavers embalmed by the Thiel method. A questionnaire was given to the participants (students and professors) when finishing the course. Similarities between the procedures performed on cadavers and on patients were investigated. The satisfaction degree was also analyzed.

Results The students recognized that the Thiel cadaver presents elasticity and aspect similar to the patient, and the practice on cadavers is considered the best method for the formation in laparoscopic bariatric surgery. The assistants were extremely satisfied with the acquired skills and considered that these courses should be included in the formation programs for bariatric surgery. The results of the survey on professors agreed with the students in considering the practice on cadavers as the best method for the formation in laparoscopic bariatric surgery. However, they highlighted as drawbacks of the Thiel cadaver, the absence of bleeding, and excessive elasticity of the tissues.

Conclusion The participants (students and professors) to the courses of laparoscopic bariatric surgery on cadaver Thiel recognize that these are the most similar model to real conditions in bariatric surgery.

Keywords Formation · Bariatric surgery · Laparoscopy · Thiel

Introduction

In the last decades, a surgical procedure was learned, based on the performance of the technique under supervision by an experienced surgeon [1–4]. This implied a long learning curve for certain procedures and was associated with the morbidity and mortality rates. Actually, the development of increasingly complex techniques and the dependence on advanced technological devices make more difficult the acquisition of new surgical skills [2–4].

In laparoscopic surgery, experimental laboratory practices are gaining relevance [4–8]. These practices include *Pelvitrainers*, virtual reality simulators, and experimental animal (generally pigs) [9]. Pelvitrainer and simulators allow the acquisition of basic laparoscopic skills, but the performance of interventions on pigs offers the opportunity to learn certain

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maneuvers in vivo. However, the use of animals is expensive and their anatomy differs from the human one. The best learning model would be to perform the surgical technique on human cadavers. However, formaldehyde is the most frequently employed embalming method and it confers a rigidity to the tissues that prevents from the performance of laparoscopic approaches. Fresh cadavers present a certain degree of elasticity and compliance, but their main drawback is the limited time for their use [5–9].

Though the Thiel embalming method is widely known, among the anatomists, few anatomic centers worldwide are developing it. Actually, there is still little evidence about the use of this cadaveric model as a learning tool for laparoscopic techniques [10–12].

The aim of this study was to assess, by means of satisfaction surveys, the perception of the surgeon (as student or professor) about the usefulness of experimental courses of laparoscopic bariatric surgery on Thiel-embalmed cadavers.

Patients and Methods

A prospective observational study was performed. The participants (students and professors) in two courses of experimental laparoscopic bariatric surgery on Thiel-embalmed cadaver filled a questionnaire to evaluate their impression and satisfaction with the course. The questionnaire was anonymous and was filled at the end of the course. The questions included in the questionnaire are described in Table 1. Twelve common questions were included, directed to the student or to the professors, aiming to analyze their opinion about the features of the Thiel-embalmed cadaver and their impression about the usefulness of these models as a learning tool for laparoscopic bariatric surgery. In the questionnaire for the students, a 13th question was included, investigating if they would like to perform practices on Thiel-embalmed cadavers more frequently.

Table 1 Content of the questionnaire

1. Before this course, did you know the Thiel embalming method? Yes/No
2. If you knew the Thiel method before, please choose one of the following options:
   a) I have heard about the Thiel method, but I have never worked with it.
   b) I have worked with Thiel-embalmed cadavers in anatomic dissections.
   c) I have worked with Thiel-embalmed cadavers in laparoscopic practices.
3. In the Thiel-embalmed cadaver, the color allows to distinguish the different tissues? Yes/No
4. In the Thiel-embalmed cadaver the elasticity of the tissues permits a realistic manipulation? Yes/No
5. In the Thiel-embalmed cadaver, the aspect of the body resembles a patient? Yes /No
6. In the Thiel-embalmed cadaver, the absence of bleeding reduces plausibility? Yes/No
7. In the Thiel-embalmed cadaver, the consistence of the viscera is lower than in a patients? Yes/No
8. Do you consider that the Thiel-embalmed cadaver is a better model for practices in bariatric laparoscopic surgery, than the pig or other animals? Yes/No
9. Do you consider that the practice in the Thiel-embalmed cadaver has been useful (for you or for the student)? Yes/No
10. Do you consider that practices on Thiel-embalmed cadaver should be mandatory before performing laparoscopic bariatric surgery in vivo? Yes/No
11. In general terms, in what way has the course responded to your expectations? (to yours or to those of the students)
    Excellent
    Good
    Normal
    Regular
    Bad
12. Which aspects would you improve for future courses? Free text.
13. Would you like to perform laparoscopic practices more frequently? Yes/No

Thiel-Embalmed Model

An anatomic specimen embalmed by Thiel model was used. Thiel method was first described by its creator, Professor Walter Thiel, in 1992 [13, 14]. This method is characterized by a sophisticated process that allows preservation of corpses preserving most of the features of a living body. The method consists in a vascular perfusion followed by immersing the body over a period of at least 1–2 months in an embalming fluid containing in different proportions: boric acid 3%, mono-ethylene glycol 10%, ammonium nitrate 10%, potassium nitrate 5%, stem solution-II 2%, sodium sulfite 7%, and formalin 2%. The cadavers may be used for many months or even years. The main advantage of the model is preserving the excellent color of muscles, viscera, and vessels. The flexibility of the peritoneal membrane and the abdominal organs is important for practices in laparoscopic surgery, allowing distension of pneumoperitoneum, and consequently allowing a correct view and manipulation of the different structures.

Methodology of the Courses

Both courses were performed in the Departments of Anatomy of two public universities. In both courses, eight Thiel-embalmed cadavers were prepared and three students were assigned in each cadaver, resembling a normal bariatric approach, with a main surgeon, a first assistant, and a second assistant with the camera (Fig. 1). The cadaver was placed in reverse Trendelenburg position with open legs. Laparoscopic devices employed were similar to those used in a normal hospital theater (Optica, camera, suction devices, ultrasonic scalpels, endostaplers, sutures,…).

A sleeve gastrectomy was the first procedure performed. The gastric sleeve could be calibrated with a 40Fr orogastric bougie, similar to real partition. As second procedure, the gastric sleeve was converted to a Roux-en-Y gastric bypass (Fig. 2). The three students changed their position during the practice, so that all of them performed a part of the techniques as the main surgeon.

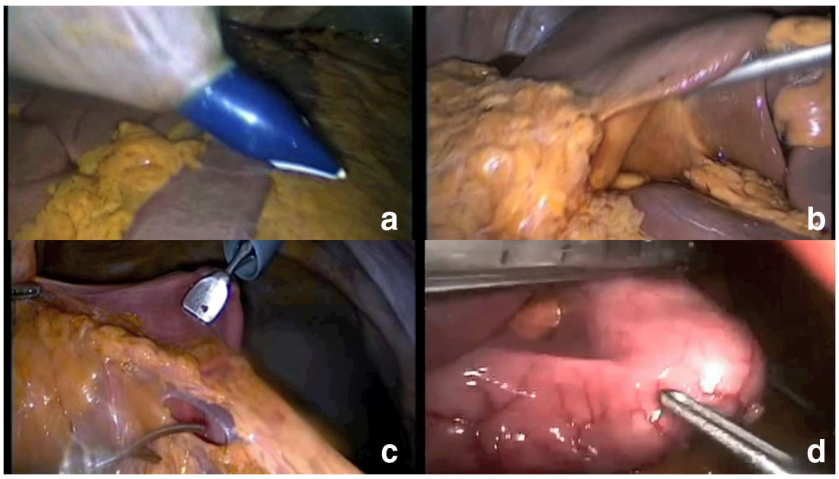

Fig. 1 **a** Trocar insertion. Elasticity of the peritoneum. **b** Liver retraction. **c** Dissection of the greater curvature and division of short gastric vessels during the performance of a sleeve gastrectomy. **d** Insertion of the bougie for calibration of a sleeve gastrectomy

Before proceeding to the practice on the cadaver, short lectures were presented, explaining the technique step-by-step, including videos illustrating each maneuver. The practice on cadavers was supervised by experienced bariatric surgeons, who also filled the questionnaire at the end of the course.

The students were young surgeons with basic laparoscopic skills and desire to begin with bariatric surgery.

Statistics

Qualitative variables were defined by the number of cases and percentages. Comparison between groups (students vs professors) was performed by means of the chi-square test. The informatic software SPSS 22.0 for Windows was used for the analysis.

Results

A total of 48 students and 16 professors participated in both courses. The students were 26 males and 22 females with a mean age of 34.2 ± 5.2 years. They have finished their formation period at least two years before. The participating professors were 12 males and 4 females. All the professors had at least a minimum experience of 5 years as bariatric surgeons.

The answers to the questions are shown in Table 2.

It is remarkable that 37.5% of the students and 25% of the professors did not know the Thiel embalming method before this course, revealing that many surgeons still do not know the existence of this method as a surgical training option. It is true that, among those ones who knew the method, most of them have performed laparoscopic practices on these models.

Both students and professors completely agreed that the Thiel embalming method allows to distinguish the different tissues; the elasticity of the tissues permits a realistic manipulation and the aspect of the corpse resembles a patient.

The absence of bleeding, considered as a reduction of plausibility, was more relevant for the students than for the professors. The professors justified their answers, considering that bariatric surgery is usually a low-bleeding procedure. Only for 25% of the professors, the absence of bleeding was a drawback of these models.

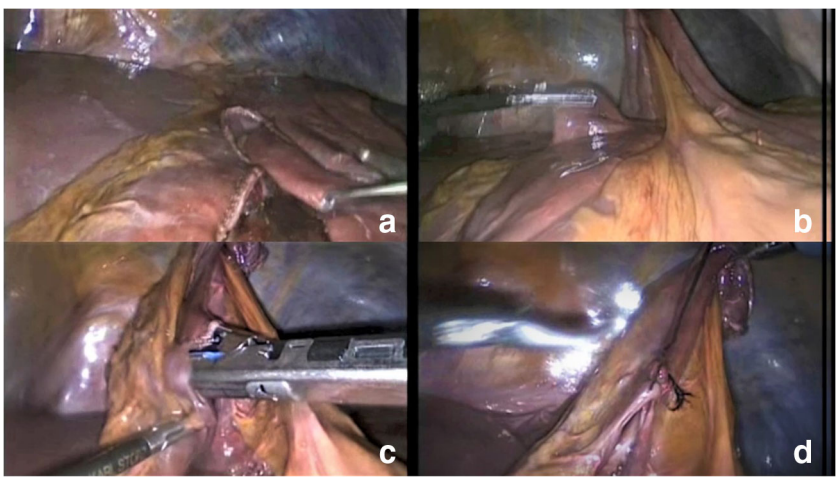

Fig. 2 **a** Gastric sleeve construction with linear staplers. **b** Small bowel measurement. **c** Gastro-jejunal mechanic anastomosis during gastric bypass. **d** The remaining holes after mechanic anastomosis were closed with a running suture

Table 2 Answers to the questionnaire by students and professors

	Students	Professors	p
Question 1	Yes 62.5% (30)	Yes 75% (12)	NS
	No 37.5% (18)	No 25% (4)	
Question 2	Never worked 14.7% (7)	Never worked 25% (4)	NS
	Anatomic dissections 2% (1)	Anatomic dissections 0%	
	Laparoscopic practices 20.8% (10)	Laparoscopic practices 50% (8)	
Question 3	Yes 100% (48)	Yes 100% (16)	NS
	No 0%	No 0%	
Question 4	Yes 100% (48)	Yes 100% (16)	NS
	No 0%	No 0%	
Question 5	Yes 100% (48)	Yes 100% (16)	NS
	No 0%	No 0%	
Question 6	Yes 68.7% (33)	Yes 50% (8)	NS
	No 31.3% (15)	No 50% (8)	
Question 7	Yes 64.6% (31)	Yes 100% (16)	0.005
	No 35.4% (17)	No 0%	
Question 8	Yes 100% (48)	Yes 100% (16)	NS
	No 0%	No 0%	
Question 9	Yes 100% (48)	Yes 100% (16)	NS
	No 0%	No 0%	
Question 10	Yes 100% (48)	Yes 100% (16)	NS
	No 0%	No 0%	
Question 11	Excellent 45.9% (22)	Excellent 68.7% (11)	NS
	Good 50% (24)	Good 31.3% (5)	
	Normal 4.1% (2)	Normal 0%	
	Regular 0%	Regular 0%	
	Bad 0%	Bad 0%	

However, a lower consistence of the víscera was described by all the professors and only 64.6% of the students. All the professors agreed that a greater elasticity of the bowel and stomach was the main difference with the real patient, and 87.5% of them highlighted it as the main drawback of the Thiel cadaver.

Both professors and students completely agreed that the Thiel cadaver is a better model for practices in bariatric laparoscopic surgery and considered that these courses should be mandatory before performing laparoscopic bariatric surgery in vivo.

All the students answered that they would like to perform more frequently laparoscopic practices on Thiel-embalmed cadavers.

Discussion

Actually, several studies mention that the anatomic knowledge is often insufficient at the beginning of the surgeons´ formation [15, 16]. In 2011, a study described that up to 80,000 deaths/year in the operation room could be prevented, and an important amount of them could be attributed to insufficient anatomic knowledge of the surgeon [17]. Independently, of the rigorous anatomic knowledge required by all the surgeons, the complexity of laparoscopic procedures requires additional trainings, and to develop a learning curve on patients is not acceptable. Thus, practices in specialized labs, including Pelvitrainers, animal training, or virtual reality simulators, are recomendable [18]. All the training methods have pros and cons, but none of them can replace the training on the human body. Training on cadavers is obviously the most appropriate training for open surgery, but in laparoscopic approaches, the rigidity of the formaldehyde-embalmed cadaver is the main problem; Pneumoperitoneum cannot be done to create a virtual cavity in the abdomen, and the tissues do not have the real elastic consistence for their manipulation. Therefore, several institutions have developed the Thiel-embalmed method [13, 14].

Thiel method is a sophisticated method for cadaver preservation. It allows to preserve most of the features of the living patient. Thus, it is an excellent tool for experimental practice in different areas in clinical practice. The main advantage of the Thiel model is the excellent color preservation of the muscles, víscera, and vessels, as it has been recognized by professors and students attending to our courses [19]. The distensibility of the peritoneum and víscera is essential for the performance of laparoscopic training, as it allows a pneumoperitoneum and so a correct view and manipulation of the structures.

In our country, there are several institutions which perform a Thiel embalming method. However, laparoscopic training courses on these cadavers are still available for few surgeons. Nearly 40% of the students and 25% of the professors attending to our courses were unaware of the existence of the Thiel method and its possibilities of application in the formation of laparoscopic surgery. And only 20% of the students had previously had the opportunity to use these corpses for laparoscopic surgery training.

Specifically referring to the formation in laparoscopic bariatric surgery, the questionnaires reveal that the cadaver Thiel has a coloration, elasticity, and appearance similar to that of the living patient, being considered by students and professors as a training method superior to that of simulators or animal models. All this means that all students recognize at the end of the course that they would like to carry out more practices on these corpses. Moreover, professors and students recommend that these courses should be compulsory within the training program in bariatric surgery, before starting the procedures on the patient.

However, students and professors also highlight some negative aspects to improve. They include the absence of bleeding and the lower consistency of the viscera. Surprisingly, the only different opinión between students and professors was referred to the consistency of the víscera; all the professors recognize that the consistency does not simulate the aspect in the living patient, but only 64.6% of students recognized it. Moreover, 87.5% of the professors highlighted as main drawback of the Thiel cadaver the excessive elasticity of the tissues. The absence of bleeding was considered a drawback of these training models in only 25% of the professors. Referring to the questionnaires, more importance was given to the absence of bleeding on the part of the professors than of the students. The Thiel method can allow to solve these aspects. To simulate bleeding, a vascular dye may be injected. And to increase the consistency of the viscera, there are modifications in the embalming formula and they can be tested to find the formula that best reproduces the real consistency of the tissues.

Although laparoscopic training on Thiel corps may seem initially very expensive, the reality is that in centers that have the infrastructure for embalming with the Thiel method, the cost is not that high, especially given the possibility of being able to perform several procedures on the same cadaver. In our opinion, the Thiel method offers an opportunity for surgeons to practice complex endoscopic surgical techniques, which will result in a shorter learning curve and better results in terms of morbidity and mortality. Therefore, we believe that both scientific societies and industry should be involved in developing this aspect of the training of a surgeon.

Conclusion

Students and professors attending to the courses of laparoscopic bariatric surgery on cadaver Thiel recognize that these are the model that best resembles the real conditions of bariatric surgery.

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Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

Statement of Informed Consent Informed consent was obtained from all individual participants included in the study.

Statement of Human Rights All procedures performed in this study were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments.

References

1. Targarona EM, Salvador Sanchis JL, Morales Conde S. Advanced training in laparoscopic surgery: what is the best model? Cir Esp. 2010;87(1):1–3.
2. Scott DJ, Young WN, Tesfay ST, et al. Laparoscopic skills training. Am J Surg. 2001;182:137–42.
3. Sroka G, Feldman LS, Vassiliou MC, et al. Fundamentals of laparoscopic surgery simulator training to proficiency improves laparoscopic performance in the operating room-a randomized controlled trial. Am J Surg. 2010;199:115–20.
4. Delgado F, Gómez-Abril S, Montalvá E, et al. Formación del residente en cirugía laparoscópica: un reto actual. Cir Esp. 2003;74(3):134–8.
5. Scott DJ, Bergen PC, Rege RV, et al. Laparoscopic training on bench models: better and more cost effective than operating room experience? J Am Coll Surg. 2000;191(3):272–83.
6. Saá Álvarez R, Losada Rodríguez J, Colina Alonso A. Enseñanza de la Cirugía: nuevos tiempos, nuevos métodos. Cir Esp. 2012;90(1):17–23.
7. Mac Fadyen JBV. Teaching, training, and clinical surgery. Surg Endosc. 2004;18:361–2.
8. Usón Gargallo J, Sánchez Margallo FM, Díaz-Güemes L, et al. Modelos experimentales en la cirugía laparoscópica urológica. Actas Urol Esp. 2006;30(5):443–50.
9. Aggarwal R, Darzi A. Technical-skills training in the 21st century. N Engl J Med. 2006;355:2695–6.

10. Giger U, Frésard I, Häfliger A, et al. Laparoscopic training on Thiel human cadavers: a model to teach advanced laparoscopic procedures. Surg Endosc. 2008;22(4):901–6.
11. Benkhadra M, Gérard J, Genelot D, et al. Thiel's embalming method widely known? A world survey about its use. Surg Radiol Anat. 2011;33:359–63.
12. Groscurth P, Eggli P, Kapfhammer J, et al. Gross anatomy in the surgical curriculum in Switzerland: improved cadaver preservation, anatomical models, and course development. Anat Rec (New Anat). 2001;265:254–6.
13. Thiel W. The preservation of the whole corpse with natural color. Ann Anat. 1992;174:185–95.
14. Thiel W. Supplement to the conservation of an entire cadaver according to W. Thiel. Ann Anat. 2002;184(3):267–9.
15. Fitzpatrick CM, Kolesari GL, Brasel KJ. Teaching anatomy with surgeons' tools: use of the laparoscope in clinical anatomy. Clin Anat. 2001;14(5):349–53.
16. Morán C. Ser médicos sin tocar un cadáver. Diario El País. [versión electrónica] 2103. [Consultado 22-01-2013]: Disponible en: http://sociedad.elpais.com/sociedad/2013/01/21/actualidad/1358788802_664958.html
17. Anatomy educators: making anatomy necessary and attractive to modern audiences. Clin Anat. 2011;24:398–408.
18. Zaid H, Ward D, Sammann A, et al. Integrating surgical skills education into the anatomy laboratory. J Surg Res. 2010;158(1):36–42.
19. Bertone VH, Blasi E, Ottone NE, et al. Preservación de Cadáveres con Mantenimiento de las Principales Propiedades Físicas del Vivo. Método de Walther Thiel. Rev Arg Anat Onl. 2011;2(3):89–92.