Minimally Invasive Surgery Training in Soft Cadaver (MIST-SC)

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Objectives: *The purpose of this study was to evaluate the surgical anatomy, tissue plane, organ consistency of soft cadaver and the possibility of minimally invasive surgery training in soft cadaver.*
Setting: *Surgical Training Center. Department of Anatomy and Department of Surgery Faculty of Medicine, Chulalongkorn University*
Design: *Prospective descriptive study*
Material and Method: *2 soft cadavers were scheduled for fully laparoscopic surgery in upper gastrointestinal, colorectal, hepatopancreatobiliary and solid organs surgery. All the procedures were performed by the experienced surgical staffs and assisted by surgical staffs and/or surgical residents. The surgical anatomy, tissue plane, organ consistency and the satisfactory in performing the procedures were recorded for evaluation.*
Results: *The surgical anatomy, the tissue consistency the anatomical plane were very well preserved with mean score of 4.72±0.45 All the surgeons were satisfied with the findings, the mean score was 4.97±0.18 All the plan procedures were completely performed with great satisfactory results.*
Conclusion: *The Minimally Invasive Surgery Training in Soft Cadaver (MIST-SC) was feasible with great satisfactory. This successful integration of basic and advanced laparoscopic procedures into the soft cadaver setting would be the next step in evolution of MIS training.*

Keywords: *Minimally invasive surgery, Training, Laparoscopic surgery, Cadaver, Soft cadaver, MIST-SC*

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The advantages of minimally invasive surgery over conventional open surgery have been well demonstrated. They have driven the adoption of these techniques and altered surgical practice. These progressions have attracted interest to both the in-training and currently practice surgeons. Of many factors, insufficient exposures to MIS procedures cause ongoing deficits in resident training for minimally invasive surgery[1].

Currently most of the residents have a repeated opportunity to assist the procedures, many have chance to perform basic laparoscopic procedures. But in cases of advanced procedures they, in addition, those surgeons currently in practice, often provides only a low volume of cases, especially the later groups have less opportunity for earning their novel skills. Many residents try gradually doing the procedures under supervision after finish residency training or wound pursue an additional year of nonaccredital fellowships focused on laparoscopic surgery. Nowadays, most practicing surgeons attend a 2 to 3 days intensive courses offering both didactic and hand-on experience and in additional exposures to clinical cases by attending with other surgeons with laparoscopic expertise[1].

In response to encourage training of high quality, residency programs need to incorporate sufficient exposure to core MIS procedures. More expert faculty should be recruited. Learning curve of a skill is also depending on many factors; one that is the number of cases a surgeon has performed a particular procedure. For the aims to minimize this number, pre-

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vent complication, keep standard in patient safety and well-being, the laparoscopic surgical skill is acquired outside the operating room. Many modalities were introduced such as video based, box trainer or computer based, the minimally invasive trainer virtual reality (MIST-VR) or animal based, the animal laboratory and the cadaver based.

All existing technology does not begin to cover the wide range of variability seen in the patients and there is no consistent independent appropriated model and some are impractical and may be cost prohibitive[8]. It's important to get familiar with the particular surgical anatomy and the challenges of degraded feedback tactile with could be partly attained by the animal model but solely it is limited and significantly different.

The soft cadaver has been developed by the Chulalongkorn University Surgical Training Center since 1998; at first it was perfectly suited for the musculoskeletal and spine systems. The later generation has much dramatically improved including the internal organ preservation which is widely utilitarian[2]. It would be great beneficial if we can combine our soft cadaver in the MIS training system which particular human anatomy familiarity and feedback tactile sensation can be gained. This novel model would accomplish the requirement for the multimodality integration MIS training.

The propose of this study was to assess the laparoscopic training in the soft cadaver with the standard laparoscopic instruments and team setting is feasible or not for the MIS training by evaluating the surgical anatomy, tissue plane, the intra-operative organ consistency, the degraded feedback tactile, and the satisfactory of the trainee in each aspect and the overall training.

Material and Method

Methodologically, this study was a prospective descriptive in evaluation in the surgical anatomy, surgical plane, the intra-operative tissue consistency and the satisfactory of the surgeon in performing the laparoscopic surgery.

2 soft cadavers were set for laparoscopic procedures all the basic and advanced laparoscope including

1) Upper gastrointestinal organs (laparoscopic posterior trunkal vagotomy with anterior highly selective vagotomy, laparoscopic cardiomyotomy, laparoscopic Nissen fundoplication, laparoscopic gastrojejunostomy)

2) Colorectal surgery (laparoscopic appendectomy, laparoscopic colon mobilization, laparoscopic anterior resection)

3). Hepatopancreatobiliary surgery (laparoscopic cholecystectomy, laparoscopic liver dissection and laparoscopic distal pancreatectomy)

4) Solid organs surgery (laparoscopic splenectomy)

5) Hernia repair (totally extra peritoneal (TEP) and transabdominal preperitoneal repair (TAPP))

The procedures were sequentially performed as following, totally extraperitoneal repair (TEP), transabdominal preperitoneal repair (TAPP), laparoscopic cholecystectomy (LC) , laparoscopic posterior trauncal vagotomy and anterior highly selective vagotomy, laparoscopic cardiomyotomy, laparoscopic Nissen fundoplication, laparoscopic gastrojejunostomy,

Fig. 1, 2 Photographs of the Minimally Invasive Surgery Training in Soft Cadaver (MIST-SC). The theater was fully equipped with standard laparoscopic set, surgeons and teams were gowned

laparoscopic appendectomy, laparoscopic liver dissection, laparoscopic splenectomy and laparoscopic distal pancreatectomy in the first cadaver and laparoscopic colonic mobilization, laparoscopic low anterior resection, laparoscopic lysis adhesion due to previous open cholecystectomy, totally extraperitoneal repair (TEP), transabdominal preperitoneal repair (TAPP), and laparoscopic appendectomy in the second cadaver.

All the procedures were performed in the standard techniques using endoscopic scissors. All the procedures had been performed by the experienced surgical staffs in those fields with their assistants as in their surgical practice. The theater was fully equipped with standard laparoscopic set, surgeons and teams were gowned, umbilical port was introduced under direct vision, CO2 was insufflated at 15 mmHg, working space was created and maintained, other ports and instruments were inserted then laparoscopic technique was applied in steps, organ was grasped and tissue dissection was proceed. The procedures had been recorded. After finished their procedures the recording papers were filled immediately for evaluations which were the quality of organ preservation, organ coloration, surgical anatomy, tissue plane, organ consistency, organ handling toleration and degraded feedback tactile.

Port introduction, working space creation, tissue dissection, the technique applying and lastly the successfulness of surgical procedure were also recorded. There were some potential difficulties such as an unflavored smelling, rigidity and inflexibility of abdominal wall, air leakage and video vision interference which were graded in the paper. Finally the satisfactory of their attending procedures were recorded which were an integration of skill into intra-operative field, the beneficial from training and their overall the satisfactory to the performing procedures.

Results

10 surgical staffs and 21 surgical residents from department of surgery faculty of Medicine Chulalongkorn University were participated in scheduled laparoscopic procedures, and 10 observers were attended (Table 1).

The tissue preservation was impressive, all the intra-peritoneal organs were looked alike the fresh organs not only the coloration but also the good anatomical plane and organ consistency with good toleration to laparoscopic equipment handling and good tactile feedback during the procedure proceeding as if they were the fresh tissues. The mean result assessed by the staff was 4.72±0.45 (Table 2).

Fig. 3, 4 Photograph of steps in laparoscopic technique applying

Table 1. Participants

Participants	N
1. Surgical staff	10
2. 4th yr. surgical resident	6
3. 3rd yr. surgical resident	6
4. 2nd yr. surgical resident	3
5. 1st yr. surgical resident	6
6. Observers	10
Total	41

Table 2. Anatomical results (1 as very poor and 5 as very excellent)

Anatomical results	Score
- Quality of organ preservation	4.80±0.42
- Organ coloration	4.40±0.51
- Tissue plane creation	4.70±0.48
- Organ consistency	4.80±0.42
- Organ handling toleration	4.80±0.42
- Degraded feedback tactile	4.80±0.42
Average	4.72±0.45

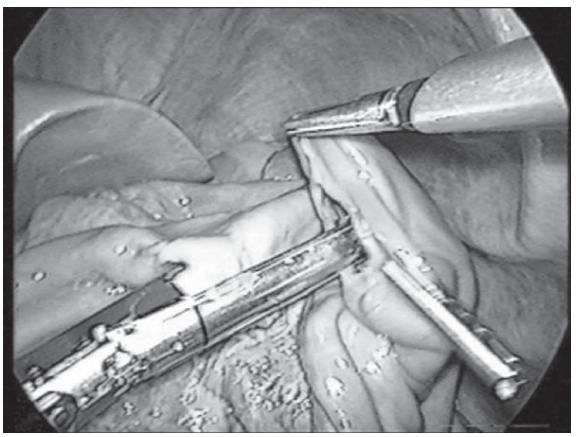

Fig. 5 Laparoscopic view of stapling

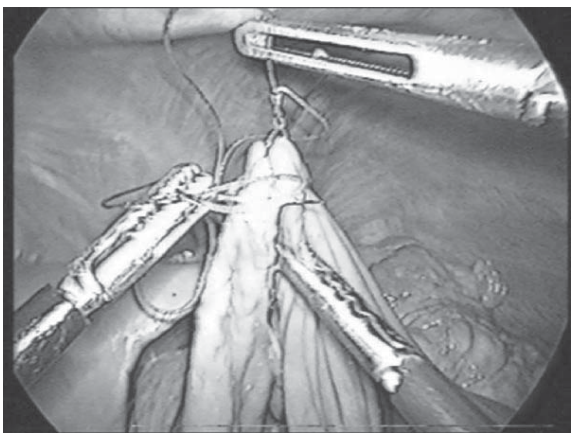

Fig. 6 Laparoscopic view of suturing

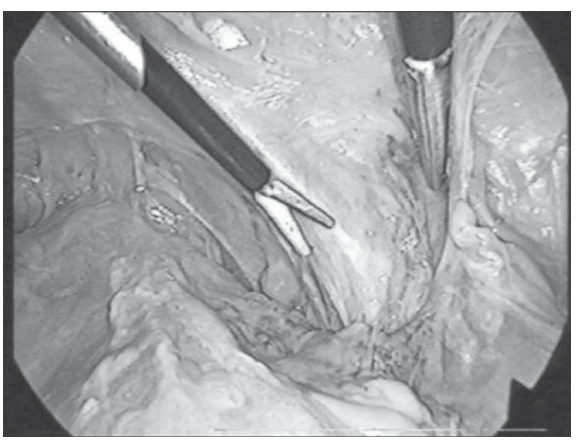

Fig. 7 Laparoscopic hernia repair (TEP)

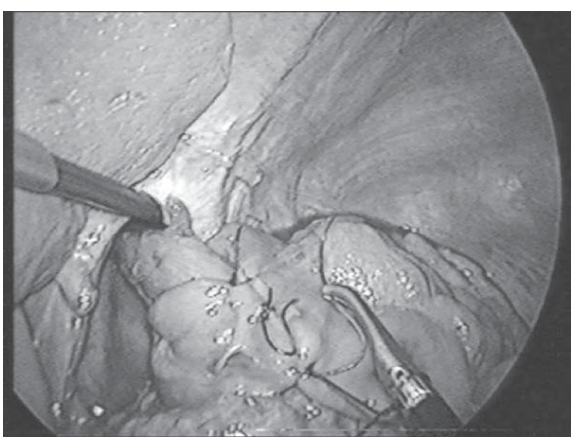

Fig. 8 Laparoscopic Nissen fundoplication

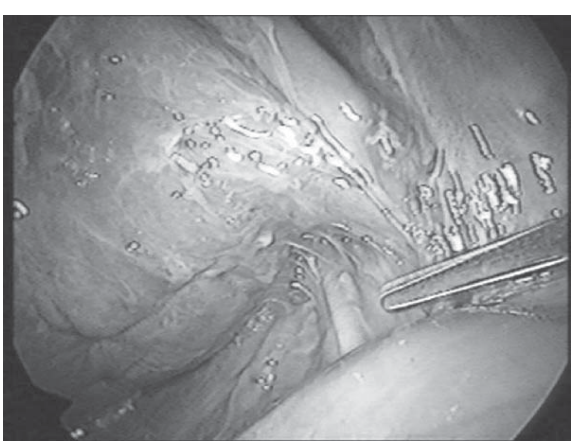

Fig. 9 Laparoscopic liver mobilization

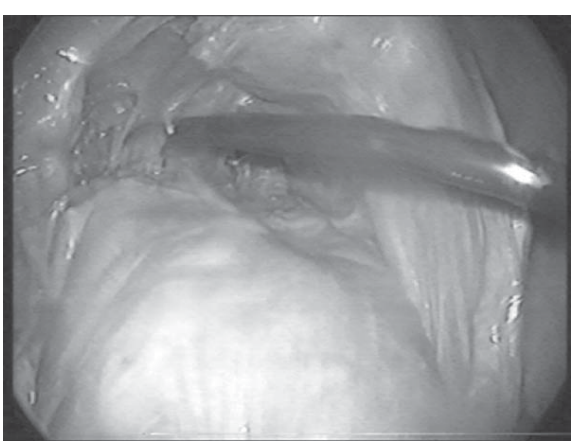

Fig. 10 Laparoscopic low anterior resection

The scheduled procedures were completely performed with great results. The step of port introduction, working space creation and tissue dissection were continued and all the laparoscopic techniques were successfully applied. The mean result was 4.8± 0.40 (Table 3).

There were some difficulties about the air leakage with could be overcome by the fixation suture. The smelling was quite a small magnitude. The abdominal wall had good extensibility which providing a huge working space. The video vision system was clear no fogging effect but some interference from the skin wax which was easy to prevent (Table 4).

All the participants were satisfied with the attending procedures in all aspects and fully gave support to the possibility of MIS training in soft cadaver. The mean satisfactory score was of 4.97±0.18 (Table 5).

Discussion

There are ongoing deficits in resident training for minimally invasive surgery in US[1]. Mainly causing from an inappropriate exposure, many modalities were introduced. All are aim to gain the skill from outside the operating room. MIST-VR is a valid tool for training of laparoscopic psychomotor skill[5] and capable for evaluating the skill necessary in laparoscopic surgery but lack of important tactile feed back[6-,8]. Animal laboratory has limitation in anatomical difference and requiring the additional personnel capable administrating animal general anesthesia[4]. Cadavers offer the most realistic training model but are expensive and limited quantity [3], there would be available only in a specific purpose.

Table 3. Surgical procedure results

Surgical procedure results	Score
- Port introduction	4.4±0.51
- Working space creation	5.0
- Tissue dissection	4.8±0.42
- Laparoscopic technique applying	4.9±0.32
- Successfulness of procedure	4.9±0.32
Average	4.8±0.40

Table 4. Difficulties and Problems

Difficulties and Problems	Score
- Unflavored smelling	1.1±0.31
- Rigidity and inflexibility of abdominal wall	1.0
- Air leakage	1.6±0.70
- Video vision interference	2.1±0.32

Table 5. Participant satisfactory

Participant satisfactory	Score
- Integration of skill into practicing	4.90±0.32
- Beneficial from training	5.00
- Overall the procedures	5.00
Average	4.97±0.18

Most the centers use the hand by hand teaching. The patient safety, standard philosophy in treatment and patient well being is the most important issue to be concerned. Getting familiar with the particular surgical anatomy and the degraded feedback tactile should be the step before starting in operative case.

From our study; the soft cadaver has been proved to be suited for MIS training. The abdominal wall has good extensibility which provides appropriated working space. All the intra-peritoneal organs are looked alike the fresh organs both consistency and anatomical plane. They are tolerated to laparoscopic equipment handling and good tactile feedback during dissection. Each step in laparoscopic procedures; port introduction, working space creation and tissue dissection are the same as the living with high satisfactory. There are some difficulties but can be easily corrected and smelling is quite a small magnitude.

MIST-SC will provide a wider opportunity for all surgeons not only the training resident but also the currently practice surgeons to gain their expertise and new techniques. Consolidated with other trainers will minimize a number of clinically learning curve, prevent uneventful complication and maximize the patient benefit.

Conclusion

From our initial attempt of evolution of MIS Training in soft cadaver, we are certainly confident that this is the dramatically incorporation of all needed for the competency in key of MIS procedures. We believe successful integration of basic and advanced laparoscopic skill into the soft cadaver setting may be the evolution of MIS training.

References

1. Park A, Witzke D, Donnelly M. Ongoing deficits in resident training for Minimally Invasive Surgery. J Gastrointest Surg 2002;6:501-9.
2. Pak-Art R, Silapunt P, Bunaprasert T, Tansatit T, Vajrabukka T. Prospective, randomized, controlled trial of proximally based vs. distally based gluteus maximus flap for anal incontinence in cadavers. Dis Colon Rectum. 2002;45:1100-3.

3. Kothari SN, Kaplan BJ, Demaria EJ,Broderich TJ, Merrell RC. Training in Laparoscopic Suturing Skills using a new computer based virtual reality simulator (MIST-VR) provides result comparable to those with an established pelvic training system. J Laparo $ endoscopic & adv surg 2002; 12:167-73.
4. Grantchalov TP, Kristiansen V, Bendix J, Bardram L, Rosenberg J, and Funch-Jensen P. Randomized clinical trial of virtual reality simulation for laparoscopic skill training. Br J Surg 2004;91:146-50.
5. Scott DJ, Bergen PC, Rege RV, Laycock R, Tesfey ST, Valentine RJ, Jones DB. Intense laparoscopic skills training improves operative performance of surgery residents. American College of surgeons Surgical Forum 1999;L:670-1.
6. Gallagher AG, Leberman AB, McGlade K, Satava RM, Smith CD. Discriminative validity of the minimally invasive surgical trainer (MIST-VR) using criteria levels based on expert performance. Surg Endosc 2004;18:660-5.
7. Feldman LS, Sherman Using simulators to assess laparoscopic competence: ready for widespread use? Surgery 2004;135:28-42.
8. Adrale GL, Chu UB, Hoskins JD, Witzke DB, Park AE. Development of a valid, cost effective laparo-scopic training program. Am J Surg 2004;187: 157-63.

การฝึกอบรมการผ่าตัดแบบ Minimally invasive surgery โดยอาศัยอาจารย์ใหญ่ ชนิดพิเศษ (soft cadaver)

สุเทพ อุดมแสวงทรัพย์, จิรวัฒน์ พัฒนะอรุณ, ธันวา ตันสถิตย์, ศุภอัฐ พึ่งพาพงศ์, พัฒน์พงศ์ นาวีเจริญ, บุญชู ศิริจินดากุล, บัณฑูร นนทสูติ, รัฐพลี ภาคอรรถ, สุกัญญา ศรีอัษฎาพร, กฤตยา กฤตยากีรณ, มาวิน วงศ์สายสุวรรณ, อรุณ โรจนสกุล

วัตถุประสงค์: *เพื่อศึกษาถึงกายวิภาค, ชั้นเนื้อเยื่อ, สัมผัสขณะผ่าตัดและความเป็นไปได้ของการฝึกอบรมการ ผ่าตัดแบบ minimally invasive surgery ในอาจารย์ใหญ่ชนิดพิเศษ*

รูปแบบการศึกษา: *การศึกษาเชิงพรรณนาชนิดไปข้างหน้า*

สถานที่ทำการศึกษา: *ศูนย์ฝึกผ่าตัด คณะแพทยศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย*

วัสดุและวิธีการ: *ทำการผ่าตัด laparoscopic surgery ใน soft cadaver โดยใช้อุปกรณ์และทีมผ่าตัดเช่นเดียวกับการผ่าตัด laparoscopic surgery แบบมาตรฐาน การผ่าตัดประกอบด้วยอวัยวะในช่องท้องด้านบน, ช่องท้องด้านล่าง, ตับทางเดินน้ำดีและตับอ่อน, และอวัยวะ solid organs ผ่าตัดและช่วยผ่าตัดโดยอาจารย์และแพทย์ประจำบ้านภาควิชาศัลยศาสตร์ คณะแพทยศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย โดยศึกษาถึงกายวิภาค, ชั้นเนื้อเยื่อ, และความรู้สึกสัมผัสขณะทำการผ่าตัด รวมถึงความพึงพอใจในการผ่าตัด*

ผลการศึกษา: *อวัยวะภายในช่องท้องได้รับการเก็บรักษาเป็นอย่างดี มีสภาพใกล้เคียงเช่นเดียวกับการผ่าตัดจริง การฝึกผ่าตัด Minimally invasive surgery โดย soft cadaver สามารถทำได้สำเร็จทุกการผ่าตัด และได้รับความพึงพอใจสูงสุดในทุก ๆ ประเด็น*

สรุป: *การฝึกผ่าตัดโดย Soft cadaver (MIST-SC) จะเป็นนวตกรรมและมีบทบาทสำคัญอย่างยิ่งสำหรับการผสมผสานทักษะที่จำเป็นกับเนื้อเยื่อและอวัยวะจริงก่อนการฝึกผ่าตัดในผู้ป่วย การฝึกผ่าตัดโดย soft cadaver (MIST-SC) จะเป็นอีกก้าวและเป็นอนาคตของการผ่าตัดฝึกผ่าตัดด้วยกล้อง*