Criteria for Laparoscopic Advanced Surgery in Semi-Equipped Setup (CLASS): Feasibility Study Based on Institutional Experience

S. K. Uday · P. R. K. Bhargav ·
C. H. Venkata Pavan Kumar

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Abstract Laparoscopic and Minimally invasive techniques have become a routine practice for various surgical disorders in present times. Though, advanced laparoscopic procedures are feasible they are largely restricted to fewer centers due to lack of advanced instrumentation, finances and expertise at most of them. In this context, we conducted a feasibility study to evolve definite criteria for performing advanced laparoscopic surgeries in resource restricted setups. We present our experience with 25 cases of advanced laparoscopic procedures using conventional laparoscopic instruments. We evaluated the clinico-investigative profile and operative details of all the patients. We classified the surgical expertise, laparoscopic instrumentation, surgical set ups and patient factors systematically to evolve the criteria for feasibility of advanced laparoscopic surgery. Out of the 22 eligible patients for the study, various laparoscopic surgeries performed were - Fundoplication (4), Cystogastrostomy (3), Endoscopic thyroidectomy (7), Thoracoscopic Thyroidectomy (2), Adrenalectomy (5) and Retroperitoneal paraganglioma excision (1). There was no mortality and two morbidities in the form of hypercarbia and a tracheo-cutaneous fistula in 2 cases of endoscopic thyroidectomy. According to the criteria, we propose our surgical set up falls in to Grade 3, for which this criteria fits in. This study demonstrates the feasibility of advanced laparoscopic procedures in semi-equipped set-up, preferably by employing institute specific criteria of CLASS.

Keywords Advanced laparoscopy · Fundoplication · Cystogastrostomy · Endoscopic thyroidectomy · Laparoscopic Adrenalectomy

Introduction

Laparoscopic surgery in modern times has become a standard practice for many intra-abdominal surgeries, ever since laparoscopic cholecystectomy was successfully performed about 25 years ago [1–3]. Advances in laparoscopic techniques, increasing experience, and instrumentation have ushered in an opportunity to continuously improvise, leading to advanced laparoscopic procedures such as fundoplication, hernioplasties, Whipple's procedure, liver resections, thoracoscopic surgeries, cystogastrostomy, and thyroidectomies [4–7]. State-of-art endovision equipments with regard to light, camera, and monitors are recommended for advanced laparoscopic procedures in present times. But advanced laparoscopic surgeries are not performed at majority of the centers due to various factors such as lack of surgical expertise, technical limitations, improper instrumentation, or combination of them. Thus, majority of surgical departments end up performing basic procedures such as diagnostic laparoscopy, appendectomy, or cholecystectomy [7], leading to severe scarcity of advanced laparoscopic centers. In this context, we evaluated our own recent experience with a series of advanced laparoscopic surgeries performed in a relatively resource-limited setup.

Material and Methods

This retrospective study was performed at general and endocrine surgery departments of tertiary care teaching

S. K. Uday · P. R. K. Bhargav (✉) · C. H. Venkata Pavan Kumar
Endocrine and Metabolic Surgery Department,
Mamata Medical College and Hospital (MMC/MGH),
Khammam, Andhra Pradesh, India
e-mail: kingbhargav@gmail.com

institute in southern India. Between July 2010 and June 2011 (12 months), 25 advanced laparoscopic procedures were performed. The procedures performed were 3 cystogastrostomies, 4 hepatogastric funduplications, 7 endoscopic thyroidectomies, 2 thoracoscopic thyroidectomies, 5 adrenalectomies, and 1 retroperitoneal paraganglioma. Three cases had been excluded due to reasons such as lack of informed consent by patients, technical failure, and conversion to open procedure. Only conventional laparoscopic instruments were used in all the procedures.

The following prerequisite criteria and paraphernalia were employed for the surgeries:

1. **Expertise:** Three operating surgeons (OS)—one surgical endocrinologist and two laparoscopic surgeons

Definition for expertise (arbitrary): Surgeons having extensive experience (not less than 5 years after postgraduation) in open surgery and basic laparoscopy including laparoscopic techniques such as intracorporeal knotting, hydrodissection, endoloop application, and hemostasis

2. Case selection:

Inclusion criteria:

- Age >18 year
- Radiologically well-defined disease (ultrasonography and/or computed tomography)
- Only elective surgery
- American Society of Anesthesiology (ASA) Grades 1 and 2 [8]

Exclusion criteria:

- Pregnancy
- Contraindication for general anesthesia
- Morbid obesity
- Previous surgery
- Uncontrolled medical conditions

3. Instrumentation:

Endo-vision: Single-chip camera, halogen light source, single nonmedical grade monitor

10 mm 30° telescope

10 mm and 5 mm trocars

Dissecting forceps

Traumatic and atraumatic grasping forceps

Monopolar hook

Bipolar forceps

Suction and irrigation cannula

Needle holder

4. Operating team:

At least two OSs

One scrub nurse—trained for laparoscopy

Same anesthesia team

All the procedures were performed under general inhalational anesthesia.

A. **Laparoscopic fundoplication** (Figs. 1 and 2): Pneumoperitoneum was created by open technique. Standard port placement was done. Gastrohepatic ligament was cut with monopolar hook. Perihial dissection was done using monopolar hook (MH), bipolar diathermy (BD), and blunt dissection to mobilize esophagus. Both vagi were identified and the esophagus was slinged. Gastric fundus was mobilized using the bipolar forceps. Short gastric vessels were clipped with endoclip. Cruroplasty was done. A 270° fundal wrap was done using intracorporeal knotting technique (ICK).

B. **Laparoscopic cystogastrostomy for pancreatic pseudocyst** (Fig. 2): This procedure was done with placement of standard four ports. Branches from main gastric vessels on either side of planned gastrotomy were secured with ICK on the gastric wall. Anterior gastrotomy was done by using MH. Hemostasis in the gastric wall was achieved with BD. An elliptical incision was taken over the posterior gastric wall at most prominent site with MH. A 2 cm×5 cm ellipse of the stomach and cyst wall was removed. Hemostasis was achieved in the similar way as for the anterior gastric wall. The pseudocyst was drained and all the contents were sucked out. After pseudocystoscopy, edge of the stomach and the cyst wall was sutured by ICK. Anterior gastrotomy was closed in two layers with ICK.

C. **Endoscopic thyroidectomy (ET)** (Fig. 3): Port placement over the anterior chest wall was done after creating subcutaneous and subplatysmal planes using subcutaneous dissector, long hemostat, and telescope. We used axillary breast approach in four and chest wall approach in three cases. Strap muscles were separated

Fig. 1 Intraoperative view of laparoscopic fundoplication showing mobilized lower esophagus (down arrow), diaphragmatic crura (solid arrow), and cruroplasty (hollow arrow)

Fig. 2 Laparoscopic fundoplication showing dissection of gastrohepatic omentum with monopolar hook (*solid arrow*) and left lobe of liver (*hollow arrow*)

in the midline using BD. The superior pole was dissected using BD, blunt dissection, and hydrodissection (HD). Superior and inferior pedicle vessels were identified and clipped with the endoclip applicator. The recurrent laryngeal nerve was identified and protected. Inferior parathyroid gland was also identified and protected at this stage. Once the inferior pole was freed, the lobe was lifted up from trachea and dissected up to the isthmus using BD and blunt dissection. Isthmus was dissected from trachea in the same way. The specimen was removed through the camera port after enlarging it.

- D. Thoracoscopic thyroidectomy for mediastinal goiters (TT):** This procedure was performed for large posterior mediastinal extension of goiters using conventional instruments, and the same criteria as

Fig. 3 Endoscopic thyroidectomy via chest wall approach—operative space creation with subcutaneous dissector (*solid arrow*) and thyroid nodule (*hollow arrow*)

described above were employed. The detailed operative technique was already published by us elsewhere [9].

- E. Laparoscopic adrenalectomy (LAD):** It was performed with standard (four subcostal ports) transperitoneal route. Three cases were right sided and one was left-sided adrenal tumors. The adrenal tumor was identified, dissected, and extirpated with minimal handling, from surrounding retroperitoneal structures. Only BD and HD with clip application were employed for vascular control. An indigenously made endobag was used for specimen retrieval to prevent tumor spillage (Fig. 4). All the procedures were uneventful both intra- and postoperatively.

- F. Laparoscopic excision of retroperitoneal paraganglioma (LRP)** (Figs. 5 and 6): Port placements were similar to those used for adrenalectomy. The tumor was situated near the right renal hilum. Extensive adhesions with surrounding structures and vascularity from retroperitoneal vessels and inferior vena cava could be dealt without the use of harmonic shears or vessel seal system.

Results

The clinic-investigative profile of the 22 cases in the study cohort is summarized in Table 1. Laparoscopic fundoplication was done for symptomatic hiatus hernia with or without significant reflux esophagitis as confirmed by videoendoscopy. All these cases had severe refractory reflux esophagitis for more than 1-year duration. After laparoscopic fundoplication, they had significant symptomatic relief and free of proton-pump inhibitors at a mean follow-up of 3 months. Three cases of pseudocysts of pancreas (PP) were

Fig. 4 Laparoscopic adrenalectomy—endobag (*solid arrow*) and specimen (*hollow arrow*)

Fig. 5 Laparoscopic excision of extra-adrenal paraganglioma—hydrodissection with irrigation cannula (*down arrow*), tumor (*solid arrow*), and inferior vena cava (*hollow arrow*)

retrogastric in location, ideally suited for laparoscopic cystogastrostomy. Two cases developed PP after single episode of acute pancreatitis and one was associated with chronic pancreatitis. All the cases that underwent ET had benign nodular goiter without comorbid conditions. Five patients underwent hemithyroidectomy, and in two cases total thyroidectomy was done. TT was done as a part of combined procedure with conventional neck approach for large goiters. TT aspect of surgery was used for the dissection of posterior mediastinal goiter and later delivered through neck in continuity with goiter in neck. LAD was done for five cases of unilateral pheochromocytoma—four right adrenal tumors and one left-sided mass. All the tumors were sporadic with no multifocality. One case of LRP was done for functional ganglioneuroma located near the renal hilum, away from the normal right adrenal gland. All the procedures were

Fig. 6 Laparoscopic excision of extra-adrenal paraganglioma—bipolar diathermy (*black arrow*); tumor (*white arrow*)

Table 1 Clinico-investigative profile

Surgery performed	Clinical diagnosis ^a	Number of cases (N=)	Sex ratio (F:M)	Mean Age (in years)	Imaging done ^b
LF	Hiatus Hernia	4	1:3	32	UGIE, BS
LCG	PP	3	0:3	27	USG, CECT
ET	Benign goiter	5	5:0	34	USG
TT	PME	3	2:1	43	CECT
Lad	Adrenal tumor	4	3:1	36	CECT
LRP	EAP	1	1:0	38	CECT

^a PP pancreatic pseudocyst; PME posterior mediastinal extension of goiter; EAP extra-adrenal paraganglioma

^b UGIE upper gastro-intestinal endoscopy; BS barium swallow; USG ultrasonography; CECT contrast enhanced computerised tomography

contemplated after thorough clinical and radiological diagnosis.

Surgery-related details including the intra-operative technical details and postoperative morbidity are summarized in Table 2. There was no mortality. One case of ET suffered from hypercarbia probably due to high insufflation pressure and one case of ET had a tiny tracheocutaneous fistula, which healed conservatively within 3 weeks. The rest of cases had no major morbidity or recurrence.

Based on logistics and laparoscopic practice patterns, we conceived three levels of institutional-based surgical setups, as shown in Table 3.

The definitions of frequency of surgeries performed are arbitrary and the criterion of advanced equipment is subjective to a particular setup. Based on the above data, we recommend this criterion for laparoscopic advanced surgery in semi-equipped setup (CLASS), as shown in Table 4.

Discussion

The field of laparoscopic and minimally invasive surgery has already crossed two important developmental hurdles: (1) clinical feasibility with safety and (2) suitable technology to perform these procedures. One of earliest reports on human laparoscopy was made by Jacobaeus in 1910, wherein air pneumoperitoneum and cystoscope were used for abdominal tuberculosis [10]. Semm et al pioneered in operative laparoscopy with the introduction of a series of laparoscopic and hemostatic equipments in 1960s and 1870s [11]. But the lack of enthusiasm in laparoscopy among general surgeons led to a long dormancy, till a major breakthrough in operative endoscopy occurred in 1982, with the introduction of solid-state video camera. Therapeutic interventions were possible with this invention and it paved way

Table 2 Operative summary

	Surgery performed	Number (N =)	Mean Duration of surgery (in minutes)	Morbidity ^a	Main instruments for hemostasis and dissection ^b
	LF	4	165	NS	MH,BD,ICK,MC
	LCG	3	220	NS	MH,BD,ICK
	ET	5	173	TCF	MH,BD,MC,HD
	TT	3	122	Hypercarbia	MH,BD,MC,HD
	Lad	4	107	NS	MH,BD,MC,HD,SC
	LRP	1	230	NS	BD,MC,ICK,HD,SC

^aNS no significant morbidity; TCF tracheocutaneous fistula

^bMH monopolar hook; BD bipolar diathermy; ICK intra-corporeal knotting; MC metallic clips; HD hydrodissection; SC surgical

for the entire operating team to get involved along with the primary surgeon. Later, the widespread practice of laparoscopic cholecystectomy established it as a gold standard for gallbladder surgery.

Laparoscopy today is firmly established in the armamentarium of surgeons around the world. In a past few decades, surgeons have acquainted themselves with basic laparoscopic procedures such as diagnostic laparoscopy, laparoscopic appendectomy, and cholecystectomy. On the contrary, a specialist in laparoscopy would endeavor to conduct advanced procedures such as colonic resections, fundoplication, hernioplasties, and splenectomy in general surgery and thoracoscopy, thyroidectomy, adrenalectomies, and urological surgeries in respective subspecialties [12–14]. This was especially made possible by active biomedical research in laparoscopic and fiberoptic fields, apart from increasing surgical expertise. High-definition three-chip camera, xenon light source, medical grade monitor, and fiberoptic cables form the essential components of endovision for performing advanced laparoscopic procedures in modern times, albeit at a heavy expenditure. The ongoing intensive research in biomedical laparoscopic field has opened up futuristic options such as single-incision laparoscopic surgery, robotics, and natural orifice transluminal endoscopic surgery [15–17]. Even surgeons are exploring newer anatomical routes such as endoluminal surgery and transoral thyroidectomy, with the availability of advanced instruments such as

flexible endoscopes, miniature endoscopes, flexible instruments, monochromatic light source, videomicroscopy, endocytology, and autosuture needles [18–21]. This rapid pace of newer inventions has put surgeons under pressure to upgrade themselves, which takes a longer learning curve to acclimatize to these instruments and technology. Thus in practice, multiport laparoscopic surgeries alone are possible and accessible for most of surgeons and centers. For securing hemostasis in laparoscopy, a wide range of gadgets such as laparoscopic clip applicators, staplers, and suturing techniques and energy sources such as monopolar and bipolar electrocautery, argon beam coagulators, laser or ultrasonic dissectors, and topical sealing agents are available [22, 23].

Various methods of hydrodissection such as injection of saline-adrenaline into tissue planes, jet irrigation, and solid organ dissection have been described [24, 25]. We utilized a technique of hydrodissection with the suction catheter to facilitate opening up of the tissue planes. This technique had an added advantage of better vision as it dislodges the

Table 3 Gradation of laparoscopic surgical set-ups

Level	Advanced equipment *	Expertise	Frequency of laparoscopic surgeries performed	Feasibility for advanced laparoscopy
1	Available	Available	Routine**	Ideal
2	Available	Not available	Rare***	Not ideal
3	Not available	Available	Frequent****	Optimal

*3 chip camera, Medical grade monitor, xenon light source, harmonic shears, ligature, staplers; ** Routine ->80 % of elective cases done laparoscopically; *** Rare -<5 % of elective cases done laparoscopically; **** Frequent ->30 % of elective cases done laparoscopically

Table 4 Criteria and checklist for feasibility of advanced laparoscopy in level 3 setup

Criterion	Sub-category	Checklist***
Expertise	- Surgeons experienced in open and basic laparoscopy - Surgeons experienced in laparoscopic techniques	
Case selection	Inclusion – - 18 to 50 years - Radiologically well defined disease - Only elective surgery - ASA grade 1 and 2	
Instruments	Basic Laparoscopic set with hemostatic instruments *	
Operating team	- Same anaesthetic team - Same nursing staff - Atleast two OS**	

* Harmonic shears, vessel seal system, staplers are not included;

OS=Operating Surgeon; * All the criteria should be checklist with a tick before contemplating surgery

minor clots and can be used for intermittent cleaning of telescope lens, off-staining and fogging, in situ without taking it out and thus saves time. ICK is a useful tool in the armamentarium of laparoscopic surgery, being an economical and efficient alternative to staplers and autosutures. ICK is still used to reinforce stapler anastomosis with seromuscular suturing at stapler and anastomotic lines. ICK also equips surgeons with ability to perform a broad range of surgeries [26]. BD facilitates in controlling most of the bleeding points and securing small to medium blood vessels. MC can play complementary role to it. MH is an effective cutting tool for gastrotomy, cystogastrostomy, and fascial dissections. An endobag was made in-house by using a sterilized drain set cover with 1.0 silk purse string suture for specimen retrieval. It was an inexpensive and effective technique. Both the diathermy sources are effective alternatives to expensive energy sources (e.g., harmonic shears). Although the use of harmonic shears or vessel sealing system and other advanced instrumentation ensures safe surgery, the logical and combined use of conventional instruments compensates for this newer technology. In spite of these advantages, the ultrasonic devices have prohibitive cost and difficulty in maintenance in all the setups, requiring a better cost–benefit analysis before universal recommendation [27].

Another potential advantage is that surgeons with basic skills can utilize, maintain, and upgrade their expertise by attempting advanced surgeries with CLASS criteria, instead of non utilization of their skills awaiting an ideal setup. The main drawback of this CLASS-based surgery is prolonged operative and anesthetic time. This is due to factors such as combination of instruments and frequent change of instruments for a single step (e.g., coagulating with BD, clipping and cutting with a scissors for dividing a pedicle instead of harmonic or vessel sealing system alone). In addition, the suboptimal vision due to conventional camera and light source instead of high-definition camera makes the surgeon extra cautious and slower for performing safe surgery. We had a morbidity of tracheocutaneous fistula after ET, probably due to thermal damage caused by BD, while dissecting thyroid lobe and isthmus off the trachea leading to localized ischemic necrosis of perichondrium. Fortunately, it was a small defect and healed conservatively with voice rest for 3 weeks. Thus, an energy source must be used away from vital structures. Prolonged operative time also exposes the patient to excessive CO₂ with risk of hypercarbia, as seen in one of our cases of ET. We used intermittent desufflation at 20-minute interval and lower CO₂ insufflation pressure with hyperventilation to counter this complication. Our detailed experience on this aspect was published elsewhere [28].

There are several contrasting studies describing the advantages of one system over the other. These studies used different endpoints such as blood loss, operative time, and

cost feasibility to demonstrate the advantages of an individual or combination of instruments such as harmonic shears or bipolar electrocautery or ligasure vessel systems [27–31]. These factors could potentially bias the result. Thus, in the absence of large-scale randomised controlled trials (RCTs), it is difficult to demonstrate the utility of one instrumentation over the other. Reserving this issue to RCTs, the first prerequisite for any advanced laparoscopic surgery is feasibility and safety. The second is other paraphernalia such as cost, surgical setup, and expertise. Similar to general surgery, the final concern is the surgeon's choice of instrumentation, and any surgery could be performed if the first and second requirements are fulfilled.

In this study, we had performed 25 advanced laparoscopic surgeries in a relatively resource-limited setup. Especially in developing countries, the additional obstacle is the cost factor, and therefore advanced laparoscopic surgery setups are not available to many surgeons. In this scenario, mastering the art of advanced laparoscopy in resource-crunch setups would be a great service to many patients. Even in such a setup (level 3), the task was only possible because we followed a definitive protocol and the aforementioned CLASS criteria for all the cases. Our CLASS criteria could help significantly in developing individual protocols in respective institutions.

Conclusion

This study demonstrates the feasibility of advanced laparoscopic procedures in the resource-limited setup, by employing the proposed criteria of CLASS or similar institution-based protocols.

Disclosure Statement There are no conflicts of interest between the authors.

References

1. Litynski GS (1998) Erich Muhe and the rejection of laparoscopic cholecystectomy (1985): a surgeon ahead of his time. *JSLS* 2 (4):341–346
2. Mühe E (1990) Laparoskopische cholecystektomie. *Endoskopie Heute* 4:262–266
3. Litynski GS (1999) Profiles in laparoscopy: Mouret, Dubois, and Perissat: the laparoscopic breakthrough in Europe (1987–1988). *JSLS* 3(2):163–167
4. Puntambekar SP, Palep RJ et al (2007) Endoscopic thyroidectomy: Our technique. *JMAS* 3(3):91–97
5. Obermeyer RJ, Fisher WE, Salameh JR et al (2003) Laparoscopic pancreatic cystogastrostomy. *Surg Laparosc Endosc Percutan Tech* 13(4):250–253
6. Frantzides CT, Moore RE, Carlson MA, Madan AK et al (2004) Minimally invasive surgery for achalasia: a 10-year experience. *J Gastrointest Surg* 8(1):18–23

7. Society of American Gastrointestinal Endoscopic Surgeons (SAGES) (1994) Framework for post-residency surgical education and training—A SAGES guideline. *Surg Endosc* 8:1137–1142
8. Owens WD, Felts JA, Spitznagel EL (1978) ASA physical status classifications. *Anesthesiology* 49:239–243
9. Bhargav PRK, Amar V, Rao K, Murthy SGK, Gayathri KB (2010) Combined cervical and video-assisted thoracoscopic thyroidectomy (CAVATT): A simplified and innovative approach for posterior mediastinal goiter. *Indian J Surg* 72(4):336
10. Litynski GS (1997) Laparoscopy—the early attempts: spotlighting Georg Kelling and Hans Christian Jacobaeus. *JLS* 1:83–85
11. Mettler L, Semm K, Shive K (1997) Endoscopic management of adnexal masses. *JLS* 1(2):103–112
12. Koppersmith RB, Salem A, Holsinger FC (2009) Advanced approaches for thyroid surgery. *Otolaryngol Head Neck Surg* 141(3):340–342
13. Zahid I, Sharif S, Routledge T, Scarci M (2011) Video-assisted thoracoscopic surgery or transsternal thymectomy in the treatment of myasthenia. *Interact Cardiovasc Thorac Surg* 12(1):40–46
14. Sountoulides PG, Kaufmann OG, Kaplan AG, Louie MK et al (2009) Laparoscopic renal surgery. *Minerva Chir* 64(4):373–394
15. Swanström LL (2009) Natural orifice transluminal endoscopic surgery. *Endoscopy* 41(1):82
16. Ballantyne GH (2002) Robotic surgery, telerobotic surgery, telepresence, and telementoring. Review of early clinical results. *Surg Endosc* 16(10):1389–1402
17. Froghi F, Sodergren MH, Darzi A, Paraskeva P (2010) Single-incision Laparoscopic Surgery (SILS) in general surgery: a review of current practice. *Surg Laparosc Endosc Percutan Tech* 20(4):191–204
18. Breda A, Villamizar JM, Faba OR, Caliolo C et al (2011) Laparoscopic live donor nephrectomy with the use of 3 mm instruments and laparoscope: initial experience at a tertiary center. *Eur Urol* 61(4):840–844
19. Remzi FH, Kirat HT, Kaouk JH et al (2008) Single port laparoscopy in colorectal surgery. *Colorectal Dis* 10(8):823–826
20. Nakamoto K, Maeda M, Okamoto T, Kameyama K, Sugita A, Hayashi E (1998) Preoperative diagnosis with video-assisted thoracoscopy with miniaturized endoscopes in general thoracic surgery: a preliminary study. *Chest* 114(6):1749–1755
21. Nissen NN, Menon V, Williams J, Berci G (2011) Videomicroscopy for use in microsurgical aspects of complex hepatobiliary and pancreatic surgery: a preliminary report. *HPB (Oxford)* 13(10):753–756
22. Klingler CH, Remzi M, Marberger M, Janetschek G (2006) Haemostasis in laparoscopy. *Eur Urol* 50(5):948–956
23. McGinnis DE, Strup SE, Gomella LG (2000) Management of hemorrhage during laparoscopy. *J Endourol* 14(10):915–920
24. Nissen NN, Grewal N, Lee J, Nawabi A, Korman J (2007) Completely laparoscopic nonanatomic hepatic resection using saline-cooled cautery and hydrodissection. *Am Surg* 73(10):987–990
25. Caliskan K, Nursal TZ, Yildirim S, Moray G et al (2006) Hydrodissection with adrenaline-lidocaine-saline solution in laparoscopic cholecystectomy. *Langenbecks Arch Surg* 391(4):359–363
26. Allen JW, Rivas H, Cocchione RN, Ferzli GS (2003) Intracorporeal suturing and knot tying broadens the clinical applicability of laparoscopy. *JLS* 7(2):137–140
27. Sasi W (2010) Dissection by ultrasonic energy versus monopolar electrosurgical energy in laparoscopic cholecystectomy. *JLS* 14(1):23–34
28. Bhargav PRK, Kusumanjali A, Nagaraju R, Amar V (2011) What is the Ideal CO₂ Insufflation pressure for endoscopic thyroidectomy? Personal experience with five cases of goiter. *World J Endocrine Surg* 3(1):3–6
29. Gelmini R, Franzoni C, Zona S, Andreotti A, Saviano M (2010) Laparoscopic cholecystectomy with harmonic scalpel. *JLS* 14(1):14–19
30. Constant DL, Florman SS, Mendez F, Thomas R, Slakey DP (2004) Use of the LigaSure vessel sealing device in laparoscopic living-donor nephrectomy. *Transplantation* 78(11):1661–1664
31. Su H, Han CM, Wang CJ, Lee CL, Soong YK (2011) Comparison of the efficacy of the pulsed bipolar system and conventional electrosurgery in laparoscopic myomectomy—a retrospective matched control study. *Taiwan J Obstet Gynecol* 50(1):25–28