ORIGINAL RESEARCH PAPER

Volume-8 | Issue-4 | April-2019 | PRINT ISSN No 2277 - 8179

INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

COMPARATIVE STUDY BETWEEEN CONVENTIONAL LAPAROSCOPIC CHOLECYSTECTOMY (CLC) VERSUS SINGLE INCISION LAPAROSCOPIC CHOLECYSTECTOMY(SILC)

General Surgery

Dr. Jasvinder Singh Associate Professor, General Surgery,VAMC, Shahjhanpur.

Dr. Amrit Pal Singh Gill* SR Urology, Mahatma Gandhi Medical College And Hospital, Jaipur. *Corresponding Author

ABSTRACT

Background: Gall stones are among the most common causes of gastrointestinal illness requiring hospitalisation. Indeed operations on billiary tract are among the most common abdominal procedure performed in the United States, with more than 6,00,000 cholecystectomies performed annually. Laparoscopic cholecystectomy which is the gold standard for the treatment of gall stone disease today. we have made an attempt to evaluate the efficacy and effectiveness of single incision laparoscopic cholecystectomy compared to the gold standard multiport laparoscopic cholecystectomy.

Conclusion: postoperative mortality , morbidity & complications were minimal & same in both groups yet the time taken for surgery ,significance conversion rate , technical difficulties & incidence of portsite infection was higher in single incision laparoscopic cholecystectomy as compared to conventional laparoscopic cholecystectomy.

KEYWORDS

CONVENTIONAL LAPAROSCOPIC CHOLECYSTECTOMY (CLC), SINGLE INCISIONLAPAROSCOPIC CHOLECYSTECTOMY(SILC)

INTRODUCTION :

Gall stones are among the most common causes of gastrointestinal illness requiring hospitalisation. Indeed operations on billiary tract are among the most common abdominal procedure performed in the United States, with more than 6,00,000 cholecystectomies performed annually. Treatment of gall stones have evolved markedly since open cholecystectomy was first described by Langenbuch in 1881[1,2]. Management has progressed through eras of nonsurgical management, laparotomy, minilaparotomy and now laparoscopic cholecystectomy which is the gold standard for the treatment of gall stone disease today[3,4,5]. In fact laparoscopic surgery is the procedure of choice for most benign gall bladder diseases unless obvious contraindication exists. The advantages of earlier return of bowel function, less post operative pain, improved cosmesis, shorter length of hospital stay, earlier return to full activity, decreased overall cost were immediately appreciated. Soon after introduction of laparoscopic surgery the idea of no scar surgery has fascinated the surgeons all over the world. Various natural orifices like mouth (trans-gastric), umbilicus and vagina are being used as portals for surgery. Termed variously as Single Port Access (SPA) surgery, Single Incision Laparoscopic Surgery (SILS) or One Port Umbilical Surgery (OPUS) or Single Port Incision Less Conventional Equipment Utilising Surgery (SPICES) or Natural Orifice Transumbilical Surgery (NOTUS)[6,7,8]. It is a novel technique which promises all advantages of minimally invasive surgery with additional advantages of reduced postoperative morbidity and improved cosmesis. One of the revolutionary methods of scarless surgery is the transumbilical single portlaparoscopic technique, in which the surgical scar is virtually concealed within the umbilicus. In 1996, Kala and his colleagues[9] reported the first case of transumbilical single port laparoscopic appendectomies. The first case of transumbilical single port laparoscopic cholecystectomy was reported in 2007 by Podolsky et al[10].There are number of case series ,studies and randomised control trials conducted for comparison of Single incision cholecystectomy vis a vis Multiport cholecystectomy, however the benefit of Single incision cholecystectomy is still debatable..In our study, we have made an attempt to evaluate the efficacy and effectiveness of single incision laparoscopic cholecystectomy compared to the gold standard multiport laparoscopic cholecystectomy.

AIMS : To study the merits and demerits of single incision laparoscopic cholecystectomy *vis a vis* multiport laparoscopic cholecystectomy surgery.

OBJECTIVES: To evaluate the single incision laparoscopic cholecystectomy and conventional laparoscopic cholecystectomy with respect to following parameters-

Time taken for surgery, post operative pain, morbidity and complications, conversion rate.

MATERIALAND METHODS:-

This present study was conducted at VAMC, Shahjahanpur on consecutive 100 symptomatic patients with USG proved gallblader disease who were admitted in surgery ward with effect from October 2016 to October 2018.

Study design:

100 consecutive patients who fit into the inclusion criteria were included in the study. 50 patients were include in the multiport cholecystectomy arm and 50 in the single incison cholecystectomy arm

The inclusion criteria were:Age of patient between 18 and 65 years ,diagnosis of chronic cholecystitis, symptomatic cholelithiasis, recurrent biliary pancreatitis, Gall Bladder (GB) polyp

The exclusion criteria were:Severe co-morbid conditions (uncontrolled diabetes, hypertension or presence of IHD),diagnosis of acute cholecystitis, Mirizzi syndrome, suspicion of GB cancer ,ASA Grade-4

Random allocation of patients presenting with symptoms suggestive of gall bladder disease with confirmatory USG study was done to the two groups using the sealed envelope technique which was opened just before the skin incision.

The two groups were as follows:-
Group1: SINGLE INCISON LAPAROSCOPIC SURGERY
Group2: MULTIPLE PORT LAPAROSCOPIC SURGERY

The details of preoperative assessment, intraoperative observation, postoperative courseand postoperative follow up were recorded in a proforma (Annexure)

Technical steps:General Anaesthesia was used in all patients.

Multiport cholecystectomy: Patient position: The patient was placed in supine position with surgeon standing on patients left side during port insertion. The position was changed later to 30 degree reverse Trendelenburg with the table rotated to left by 15 degree during surgery.

Port placement: A 10 mm port was inserted through supraumbilical or umbilical incision by open technique. Pneumoperitoneum was created. Another 10mm port in the epigastric region, a 5mm port in right subcostal area in midclavicular line and a 5mm port in right flank in anterior axillary line were placed under vision.

Dissection: The gall bladder was grasped at fundus and retracted over the liver edge. With a second grasper the gall bladder infundibulum

was retracted laterally to expose the triangle of Calot. Dissection was done with dissecting forceps inserted through the epigastric port. The peritoneum, fat and loose areolar tissue around the gall bladder and cystic duct were dissected off towards the bile duct. After the cystic duct was identified and dissected free, dissection and identification of cystic artery was done. Three titanium clips were placed on the cystic duct and the duct was divided between the clips. Cystic artery was similarly clipped and divided. Dissection of gallbladder off the liver bed was performed in the retrograde fashion.

GB fossa was checked for any bleeding and secure placement of clips on cystic duct and artery. Any blood or bile accumulated during the procedure was removed with the suction irrigation cannula. If any bile or blood was expected to accumulate, a suction drain (18F) was placed in Morrison's pouch through the 5mm flank port. The gall bladder was removed through the epigastric port. Under vision the accessory ports were removed after checking for haemostasis. The abdomen was deflated and the 10 mm ports closed with sutures.

Single incision cholecystectomy: Patient position: The patient was placed in supine position with surgeon standing at patients left side during port insertion. The position was changed later to 30 degree reverse Trendelenburg with the table rotated to left by 15 degree during surgery.

Port placement: About 3.5 cm incision was taken through the umbilicus and deepened in layers to gain open access to peritoneal cavity. Pneumoperitoneum was created by attaching carbon dioxide tubing to the veres needle. Three ports one central 10mm and two 5mm latel ports are inserted.

Dissection: A 30 degree telescope was inserted through the central 10mm port . A dissecting forcep was inserted through right lateral port. Suture with straight needle is inserted through anterior abdominal wall from RHC area and traction is given by needle by lifting Gallblader from fundus . A combination of straight and angulated instruments was used. Calot's triangle was dissected identifying the cystic duct and artery.

30 and zero degree telescopes were used as and when required to improve visualisation and reduce clashing of instrument with optic cable.. After the dissection was completed a vascular clip applicator with 10 mm jaws and 5mm shaft loaded with clip was inserted through 10mm port .Telescope was changed and 5mm telescope was inserted through 5mm port.. The cystic duct and artery were clipped and divided between clips. GB was dissected from the liver bed with the help of hook and electrocautery.

Hemostasis and secure placement of clips checked. Any blood or bile accumulated during the procedure was removed with the suction irrigation cannula. If any bile or blood was expected to accumulate, suction drain 18 F was placed in Morrison's pouch through separate incision in right flank. The gall bladder was delivered out with the port. Rectus sheath was sutured with vicryl no 1. Skin sutured with ethilon

Statistical analysis:
The collected data was entered prospectively in Microsoft Excel 2000 and analyzed using SPSS 7.5 software. The results were tabulated for statistical analyses to identify significant differences between the two groups. Categorical variables were compared using chi-square test or Fisher's exact test. Continuous variables were analyzed using Student's t test or Mann–Whitney U test. A p value of <0.05 was considered significant.

OBSERVATIONS AND RESULTS:
Trial design: 118 patients were considered for inclusion in the study. Of these 18 patients were excluded due to multiple reasons.50 patients presenting with benign gallbladder disease were operated upon with the general intent of performing single incision cholecystectomy surgery. Outcomes of these patients were recorded along with outcomes of 50 other patients operated by multiport technique for benign gallbladder disease.6 patients in the single incision were converted to the multiport group due to various reasons. They were excluded from the final analysis.

Majority of presenting patients were in age group 40-50 years. There was no significant difference in the mean age of patients operated by the two techniques. (Table 1 & 2)

Table 1: Age wise distribution of cases in study groups

Age(yrs)	Single incision	Multi port	Total
30-40	11	17	28
40-50	23	19	42
50-60	13	07	20
60-70	03	07	10
Total	**50**	**50**	**100**

Table 2: Comparison of age in study groups:

Parameter	Single Incision	Multi Port	P Value
	Mean±SD(n=50)	Mean ± SD(n=50)	
Age(yrs)	46.4±8.53	45.24±10.34	>0.05 (NS)

64% of the operated patients were males and 36% females and there was no significant
difference among the two groups (Table 3).

Table 3: Sex wise distribution of cases in study groups:

Sex	Single incision	Multi port	Total	p value
Male	33	31	64	p = NS
Female	17	19	36	
Total	50	50	100	

Table 4: Intraoperative findings of anatomical variations, adhesions

Intraoperative observations	Single incision group (n=50)	Multiport group (n=50)	Total (n=100)	P value
Anatomical variation	1(2)	0(0)	1(1)	NS
Adhesions	13(26)	11(22)	24(24)	NS

Significant difference in the conversion rate was found in the two groups . Patients in the single incision were converted to the multiport group due to various reasons. They were excluded from the final analysis. Out of these 6 patients, technical difficulty was encountered in three patients Intraoperatively and in one patient, anatomical variation in form of long and low inserting duct was noticed due to which these cases were converted to multiport technique.

No statistically significance rise in surgical complications occurred in the patients operated by single incision technique as compared to multiport surgery .One of the patients who underwent single incision cholecystectomy had Liver injury while one patient who underwent multiport cholecystectomy had vessel injury and liver injury.

Complications due to pneumoperitoneum did not occur in either group.

Table 5: Comparison of complication in study groups

Complications	Single Incision (n=44)	Multi Port(n=50)
Vessel injury	0	1
CBD injury	0	0
Liver injury	1	1
GB injury	0	0
Others injury	0	0
Total	1	2

Median time required to complete cholecystectomy by single incision technique was significantly higher than that required for multiport cholecystectomy.

Table 6: Comparison of duration of surgery in study groups

Parameters	Single Incision	Multi Port	p value
	Mean±SD(n=44)	Mean±SD(n=50)	
Duration(min)	73.75±20.68	40.1±7.52	<0.05
Range(min)	35-120	25-55	<0.05

No difference was found in the duration of postoperative pain experienced in the two groups. Average duration of postoperative pain as deduced from requirement of analgesic was48-72hours.

Postoperative complaints of nausea and vomiting occurred in almost equal number of patients in the two groups.3 patients who underwent Single incision Cholecystectomy and 2 patients who underwent Multiport Cholecystectomy experienced shoulder pain. Other complaints like urinary retention, headache occurred in 2 cases who underwent single incision Cholecystectomy and 1 case who underwent Multiport Cholecystectomy.

Patients operated by single incision technique had a postoperative

hospital stay of mean 2.12 days, almost same as for patients operated by multiport technique. Significant postoperative port site infections was observed with the SILC

Table 7: Port site infection at first follow up in study groups

Port site	Single incision(n=44)	Multiport(n=50)	P value
infection Present	6	0	<0.05

DISCUSSION:

Out of 50 patients operated by single incision surgery 33 were and 17 were females. In the multiport group distribution was 31 males and 19 females. Majority patients were in 40-50 age group. The mean age of patients in single incision group was 46.4± 8.53 years and in multi port group was 45.24±10.34 year.

Table 8: **Comparison of age and sex distribution with other studies**

	Age(yrs)	Sex(%)	
		Male	Female
Our study	46.4(mean)	64	36
Hodgeett,et al(2009)23	50(median)	20.6	79.3
Erin,et al(2009)24	44.9(mean)	10	90
Rao PP,et al(2008)20	23-67(range)	20	80
Lee,et al(2009)21	47.5±12.2(mean)	35.1	64.8
Kravetz,et al(2009)22	43.59(mean)	20	80

Most other studies shows female preponderance (Table 8). In our study the distribution was male preponderance due to a specific type of clientele.

The intra operative observations of anatomy were made. Peri gall bladder adhesions were present in 26% patients in single incision and 22% patients in multiport group. One patient had anatomical variation in the form of long and low inserting cystic duct. Majority conversions in single incision group occurred in gall bladders with adhesion suggesting chances of conversion are high if a patient had acute or chronic cholecystitis

The conversion rate for single incision cholecystectomy was 12%. In a study conducted by P.P Rao et al (2008)[20] single incision surgery using a conversion rate of 15% was seen in another study done by Sang Kuon Lee et al (2009)[21] a conversion rate of 13% was observed. While the conversion rate of single incision surgery in our study was significantly higher than that of multiport surgery it matches fairly with the conversion rates in other studies (Table 9).

Table 9: Comparison of conversion rate with other studies

Studies	Rate of conversion (%)
Our study	12
Hodgeett,et al(2009)23	6
Erin,et al(2009)24	5
Rao PP,et al(2008)20	15
Lee,et al(2009)21	13
Chow,et al(2010)25	0
Sinan Ersin et al(2010)24	5
Abd Ellatif ME, Noaman N et al (2013)25	0

Table 10: Reasons for conversion of single incision surgery to two port, multiport or open

Reasons for conversion	2 port	Multiport	Open	Total
Technical difficulty	0	3	0	3
Anatomical variation	0	1	0	1
Haemorrhage	0	1	0	1
Structure injury	0	1	0	1
Total	0	6	0	6

Almost all conversions occurred during the first 15 cases. Technical difficulty was the leading causes of conversion in our study (Table 10). Intraoperative complication of liver injury injury to GB fossa occurred in one patient of the 44 operated by single incision technique. No rise in intraoperative complication as compared to multiport surgery was observed in our study.

In the study conducted by Sang Kuon Lee et al (2009)[21] one case of right hepatic duct injury, 11 GB perforations, 2 mesenteric injury are mentioned. In most of the other study no intraoperative complications occurred. In the case series by Sinan Ersin et al (2010)[24] one case was converted due to failure of Trocar insertion. The results in our study are in agreement with those of other studies. Complication due to pneumoperitoneum did not occur in either group.

The median time required for single incision cholecystectomy in our study was 60 min which is significantly high when compared to median time of 40 min required for multiport cholecystectomy.In the case series by Sinan Ersin et al (2010)[24] the duration of surgery for single incision cholecystectomy ranges from 105-110 min with a mean of 94 min, another study done by Rao PP,et al(2008)[20] showed a mean duration of surgery of 40 min. The duration of surgery for single incision cholecystectomy in our study compared satisfactorily with that in other studies.

Table 11: Comparison of time required for surgery with other studies

Studies	Time required for surgery(min)	
	Range	Mean/Median
Our study	35-120	60(median)
Hodgett,et al(2009)[23]	--	72±17.3(median)
Erin,et al(2009)[24]	105-110	94(mean)
Rao PP,et al(2008)[20]	19-100	40(mean)
Lee,et al(2009)[21]	30-210	83.6±40.2(mean)
Chow,et al(2010)[25]	60-276	127(mean)
Kravetz et al(2009)[22]	50-160	--
Prasad A, Mukherjee KA, Kaul S(2011).[28]	--	67(mean)
Culp BL, Cedillo VE, Arnold DT.(2012)[29]	35-141	65(mean)

In study published by Abd Ellatif ME et al (2013)[27] found significantly improved pain profile in patients who underwent Single incision cholecystectomy. In a study conducted by Bucher P et al (2012)[30] significantly less pain was observed in patient who underwent LESS.In another study done by Prsasad a et al (2011)[33] there was significant difference in postoperative pain between the two groups who underwent single incision cholecystectomy and multiport cholecystectomy. In our study we also got no significant difference in postoperative pain between the two groups.

Table 12: Comparison of postoperative pain between the two groups.

Studies	Pain score compared on VAS at 6 hours and on day 1 postoperatively
Our Study	Non signicant
Abd Ellatif ME et al (2013)[27]	Significant
Lai EC, et al(2012)[31]	Non significant
Bucher P et al (2012)[30]	Significant
Asakuma M,et al (2011)[32]	Significant
Prasad A, et al(2011)[33]	Significant

In our study common postoperative complaints were nausea (singleincision group 4.54%,multiport group 8%) vomiting (single incision group 6.81%,multiport group 6%)and shoulder pain(single port group 6.8%,multiport group 4%).Urinary retention in one patient in postoperative period was reported in study conducted by Hodgett et al(2009)[23].No postoperative complication like bleeding or bile leak occurred in either group in our study. In study conducted by Chow et al (20102)[25] bile leak from accessory duct of Luschka was noted in one case.

Table 13: Comparison of postoperative complaints between the two groups.

Studies	Complaints(nausea,vomiting,shoulder pain, others)	
	Single incision	Multiport
Our Study	23%	20%
Hodgett et al(2009) 23	10%	0%

Mortality was 0% in both the groups.

Length of postoperative stay in our study for single incision group (2.12±0.34 days) was almost same as postoperative stay required by multiport surgery patients (2.13±0.35 days).In the converted cases the multiport surgery patients with gall bladder perforation on 3rd day after drain removal on 2nd day, other patients were discharged on day 2 or 3 same as single incision operated cases.In study conducted by Kravetz et al(2009)[22] Post operative stay range was 1-4 days for patients who underwent singleincision cholecystectomy,another study done

byErsin,et al(2009)[24] hospital stay for single incision group was one day.Postoperative hospital stay in our study ranged from 2-3 days in patients who underwent singleincision cholecystectomy which is compared fairly with that in other studies.

Table 14: Comparison of post op hospital stay with other studies

	Post op hospital stay (days)
Our study	2-3
Kravetz et al(2009)[22]	1-4
Hodgett,et al(2009)[23]	1±0.61
Ersin,et al(2009)[24]	1
Lee et al(2009)[21]	2.7±1.5
Chow,et al(2010)[25]	1
Culp BL, Cedillo VE, Arnold DT.(2012)28	2.8

6 cases of port site infection occurred in the single incision group whereas patients who underwent multiport cholecystectomy had no port site infection which is statistically significant.(13.63%)

In one patient operated by single incision technique blackening of skin around incision occurred.

Three patients complained of continued pain in epigastric region at first follow up in single incision group, none of the patients in multiport group complained of same. The difference is statistically insignificant. Pain in epigastric region post cholecystectomy is mostly attributed to pre-existing gastritis in which case the pain in epigastric region is not relieved after cholecystectomy and is generally not procedure related. At second follow up none of the patients in the two groups had any complaints.

SUMMARY AND CONCLUSIONS

In our study the following conclusions were made

1. Technical difficulty and inflammatory changes due to chronic cholecystectomy are the leading causes of conversion from single incision to multiport cholecystectomy
2. No rise in intra and post operative complications occurred in the single incision surgery even with the technical drawbacks of the procedure
3. Time required for single incison surgery is significantly higher than multiport cholecystectomy.
4. Degree of postoperative pain is same in both groups.
5. Length of postoperative hospital stay for single incision cholecystectomy is same as for multiport cholecystectomy.
6. Postoperative port site infection was significantly higher in single incison cholecystectomy as compared to multiple port cholecystectomy.
7. Mortality was nil in the present study

Though postoperative mortality, morbidity & complications were minimal & same in both groups yet the time taken for surgery, significance conversion rate, technical difficulties & incidence of portsite infection was higher in single incision laparoscopic cholecystectomy as compared to conventional laparoscopic cholecystectomy.

REFERENCES

1) L. Morgenstern. Carl Langenbuch and the first cholecystectomy. Surgical endoscopy 1992; Volume 6,Number-3,113-114
2) Beal JM. Historical perspective of gall stone disease. Surg Gynecol Obstet. 1984 Feb;158(2):181-9.
3) Soper NJ, Stockmann PT, Dunnegan DL et al. Laparoscopic Cholecystectomy:The New 'Gold standard'? Arch Surg 1992;127S:917-921
4) Soper NJ, Brunt LM, Kerbl K. Laparoscopic General Surgery. N Eng J Med 1994;330: 409-419
5) Gall Stones and Laparoscopic cholecystectomy, NIH consensus statement online 1992;10(3):1-20
6) Kalloo AN, Singh VK, Jagannath SB, Niiyama H, Hill SL ,Vaughn CA et al. Flexible Transgastric Peritoneoscopy: A Novel approach to diagnostic and therapeutic interventions in the peritoneal cavity. Gastrointest Endosc 2004;60:114-117
7) Reddy N, Rao P Per oral Transgastric Endoscopic Appendectomy in Human.A bstract presented at 45th Annual Conf of the society of Gastrointestinal Endoscopy of India;Feb 28-29.2004.Pp.Jaipur,India
8) Dunkin BJ. Natural Orifice Transluminal Endoscopic Surgery (NOTES):Educational Challenge. World J Gastrointestinal Surg 2010;2:224-230
9) Kala Z, Hanke I, Neumann C.A modified technique in laparoscopy assisted Appendectomy- a transumblical approach through a single port. Rozhl Chir 1996;75:15-18.
10) Podolsky ER, Curcillo II PG, Rottman SJ. Single port access(SPA) surgery- of initial experience of a novel minimal access approach applied across surgical specialities. Surg Endosc 2008;22:S172
11) Jon P.Nicholl a, John E. Brazier a, Ahmad Assalia b, Moshe Schein b, Doron Kopelman b, Moshe Hashmonai b, L.R. Murmu c. Laparoscopic versus mini-incision cholecystectomy. 1993;341:47-48.
12) Reddick E, Olsen D, Spaw A, et al. Safe performance of difficult cholecystectomies. Am J Surg 1991; 161: 377-381.
13) Barkun JS, et al. RCT of Laparoscopic vs minicholecystectomy.Lancet 1992;340:1116-1119.
14) Deziel D,et al .Complications of Laparoscopic Cholecystectomy:A National Survey of 4292 Hospitals and An analysis of 77604 cases.Am J Surg 1993:165;9-14.
15) Cooperman A.Laparoscopic Cholecystectomy for severe acute embedded and gangrenous cholecystitis.J Laparoendosc Surg 1990;1:37-40.
16) Rattner D,et al.Factors associated with successful Laparoscopic Cholecystectomy for Acute Cholecystitis.Ann Surg 1993;217:233-236.
17) Wani NA,Wani KA et al.Minimum Access Cholecystectomy.Ind J Surg 1995;8:13.15.
18) Navarra G,Pozza E, Occhionorelli S,Carcoforo P and Donini I.One wound Laparoscopic Cholecystectomy.Br J Surg 1997 May;84(5):695.
19) Gregory Piskun and Sanjeev Rajpal.Transumbilical Laparoscopic Cholecystectomy utilises no incision outside the umbilicus.Journal of Laparoendoscopic and advanced Surgical technique 1999; 9:361-364.
20) Prashant P.Rao,Sonde M.Bhagwat,Abhay Rane ,Pradeep P.Rao.The feasibility of single port Laparoscopic Cholecystectomy;A pilot study of twenty cases.Journal of Internatoional Hepatopancreatobiliary Association.2008;10(5):336-340.
21) Sang Kuon Lee MD PhD,Young Kyouns You,MD PhD,Jung Hyun Park MD,Kyung Keun Lee MD,Dong Goo Kim MD PhD.Singleport Transumbilical laparoscopic Cholecystectomy:A preliminary study in 37 patients with Gall Bladder disease.Journal Laparoscopic and advanced Surgical Technique 2009;19(4):495-499.
22) Amanda J.Kravetz MD,Douglas Idai Do,Maren Barron MD PhD MBA,Michael A.Kia D O.The learning curve with single port cholecystectomy.2009;3:332-336.
23) Steven E Hodgett and Jonathan M Hernandez and Connor A.Morton and Sharona B. Ross and Michael Albrink and Alexender S. Rosemurgy.Laparoendoscopic single site (LESS) Cholecystectomy.J Gastrointest Surg 2009; 13:188-192.
24) Sinan Ersin,Ozgur Firat,Murat Sozbilen.Single Incision Laparoscopic Cholecystectomy:Is it more than a challenge?Surg Endosc 2010;24:68.
25) Andre Chow,Sanjay Purkayastha,Omer Aziz,Paraskevas Paraskeva.Single Incision Laparoscopic Surgery for Cholecystectomy:An Evolving Technique.Surg Endosc 2010;24:709-714.
26) Ostlie DJ,.J Laparoendosc Adv Surg Tech A. 2013;23(6):553-5.
27) Abd Ellatif ME et al Surg Endosc. 2013;27(6):1896-906.
28) Culp BL, Cedillo VE, Arnold DT,Single-incision laparoscopic cholecystectomy versus traditional four-port cholecystectomy,Proc (Bayl Univ Med Cent). 2012;25(4):319-23.
29) Alptekin H, J Laparoendosc Adv Surg Tech A. 2012 ;22(8):731-7.
30) Bucher P, Br J Surg. Randomized clinical trial of laparoendoscopic single-site versus conventional laparoscopic cholecystectomy 2011;98(12):1695-702.
31) Lai EC, Am J Surg. 2011 Prospective randomized comparative study of single incision laparoscopic cholecystectomy versus conventional four-port laparoscopic cholecystectomy. Sep;202(3):254-8.
32) Asakuma M ,Br J Surg. 2011 Impact of single-port cholecystectomy on postoperative pain. Jul;98(7):991-5.
33) Prasad A, Mukherjee KA, Kaul S, Kaur M , Postoperative pain after cholecystectomy: Conventional laparoscopy versus single-incision laparoscopic surgery, J Minim Access Surg. 2011 Jan;7(1):24-7.