ORIGINAL ARTICLE

COST DIFFERENCE OF ENHANCED RECOVERY AFTER SURGERY PATHWAY VS. CONVENTIONAL CARE IN ELECTIVE LAPAROSCOPIC CHOLECYSTECTOMY

Muhammad Shaheer Akhtar, Nadim Khan, Abdul Qayyum, Said Zaman Khan
Department of General Surgery, Lady Reading Hospital, Peshawar-Pakistan

Background: Enhanced recovery after surgery (ERAS) is a perioperative bundle aimed to reduce surgical stress. Significant reductions in length of hospital stay and associated costs have been reported in multiple studies in all surgical specialties. Purpose of the study was to compare the effect of Enhanced recovery protocols vs. conventional care on perioperative length of hospital stay and cost per patient in a government funded hospital. **Methods**: this randomized controlled trial was conducted in the department of General Surgery, unit B, Lady reading hospital, Peshawar from April to December 2018. One hundred and fifty patients were selected based on consecutive sampling. Random allocation into two groups of 75 (ERAS vs Conventional) was done based on computer generated numbers. Length of hospital stay and total direct costs were calculated. Frequency of Surgical site infections, readmissions and mortality was also recorded. Patient reported outcomes were recorded by Surgical Recovery Scale SRS. **Results**: Patients in the Enhanced recovery group showed a significant reduction in length of hospital stay 28.9 hours in ERAS group vs 40.5 hours in Conventional care group (p<0.001). Total per patient cost was reduced in the ERAS group PKR 6804 in comparison to the conventional care PKR 7682 (p<0.001). Patient reported outcomes measured on Surgical Recovery Scale SRS on discharge, day 3 of discharge and day 10 of discharge showed no significant difference between the two groups. **Conclusion**: Enhanced recovery protocols demonstrated a reduction in length of perioperative hospital stay and total cost despite similar post discharge recovery scores on Surgical Recovery Scale SRS and no increase in readmissions.

Keywords: Minimally Invasive Surgery; Cholecystectomy; Laparoscopic; Hospital costs; Perioperative Care

Citation: Akhtar MS, Khan N, Qayyum A, Khan SZ. Cost difference of enhanced recovery after surgery (eras) pathway vs. Conventional care in elective laparoscopic cholecystectomy–a randomized control trial. J Ayub Med Coll Abbottabad 2020;32(4):470–5.

INTRODUCTION

Over the last half century, perioperative morbidity and mortality has significantly declined.[1,2] Bainbridge *et al.* estimated the reduction of perioperative mortality in major surgeries from 10603 per million before 1970s to 1176 per million in 1990s and 2000s.[1] As most of the major surgical techniques were described by 1960s.[2] Most of these observed changes have been attributed to better perioperative care, introduction of newer technology and better understanding of physiology and the reduction of surgical stress.

Over recent years reduction in surgical stress has contributed significantly to reduced complications by up to 50% in colorectal surgery according to a metanalysis by Vardhan and colleagues [relative risk (95% confidence interval): 0.53 (0.44, 0.64)].[3] Confirmed by Greco and colleagues as reduction of overall morbidity [relative ratio (RR) = 0.60, (95 % CI 0.46–0.76)][4]. And significantly reduced length of hospital stays in colorectal.[5–8] Upper GI,[9–11] gynecological,[12–14] Hepaticoboiliary[15–17] and other surgeries.

This led to the concept of bundled perioperative protocols: Enhanced Recovery Pathway/Fast track surgery. Due to understanding the neurohormonal processes involved in response to the stress induced by the surgery itself and combining the interventions to counter the stress in a standardized bundle.[18] It was pioneered by Henrik Kehlet in colorectal surgery[19] and since has been increasingly applied in other branches of surgery for reducing surgical stress and its associated organ dysfunction[20].

Although individual components of Enhanced recovery pathway existed for a long time, Kehlet demonstrated that it was the application of these components in a coordinated bundle that the length of hospital stay in major colorectal surgery can be reduced from 10 to 2 days.[19] With the emergence of further evidence, the wide range of differences between individual practices at different centres had to be met. ERAS society was founded in Sweden registered in 2010.[21] (www.erassociety.org). The society has so far produced its recommendations on several surgeries.

One Aspect of ERAS is that it reduced length of hospital stay[9–17] and its associated costs to the health system and patients[22,23], without any increase in

complications, readmissions or delaying recovery[9–11, 22, 23].

In Pakistan, Government funded Autonomous hospitals are the major healthcare providers.[24,25] Although components of ERAS are in practice, very few centres practice the fast track protocol as a standard of care. Being a developing country with limited resources, a perceived increase in cost is one hurdle to Enhanced recovery pathway implementation.[26] As there is evidence emerging from different specialties all over the world demonstrating a reduction in cost and Length of hospital stay.[22,23] We sought to demonstrate the effect in Cholecystectomy: the surgical removal of gallbladder. We chose Cholecystectomy for its relatively wide practice in Public Sector hospitals.[27] The few studies performed demonstrated a reduction in length of hospital stay without an increase in complication or readmission rates.[28] Our study will provide our anaesthesia, surgery and nursing staff experience with the ERAS protocols. While there is a severe deficiency of health staff and resources by international standard (one doctor for 957 persons and one hospital bed for 1,580 person according to 2017-18 Pakistan Economic survey.[29] ERAS has the potential to treat more patients in the same limited resources if a cost benefit is demonstrated in a limited resource setting. To our knowledge none of the cost analysis studies were performed in a govt funded fixed resource hospital in Pakistan.

METERIAL AND METHODS

The study was approved by ethics committee lady reading hospital Peshawar. One hundred and fifty patients were selected by consecutive sampling after meeting our inclusion and exclusion criteria. (Table-1) After informed consent they were randomly allocated in two groups. Randomization was done by computer generated numbers. One group was named ERAS group and the other conventional care group. Blinding could not be performed. Patient demographics Age, sex, BMI, ASA score, tobacco use, diabetes status was recorded. In the perioperative period appropriate perioperative bundle was applied to each group. (Table-2) Outcomes like Length of hospital stay (hours) and total cost of hospitalization was recorded for each patient. The cost only included pharmacy and disposables. Personnel and other fixed hospital resources cost was not recorded as they are already Government funded at our hospital. Frequency of surgical site infection and readmissions was recorded. Total Opioid dose was recorded in morphine equivalent units. Surgical recovery scale (SRS)[30] was used to assess recovery at baseline (before operation), discharge, day 3 of discharge (call home) and day 10 of discharge (follow up). Difference of each score from the baseline for all patients was calculated and their means compared in both groups.[31]

Patients were discharged once they met the discharge criteria as given below.

- adequate pain relief using oral analgesia
- no evidence of wound complications
- no post op complications
- vitals in normal range
- ambulatory
- tolerating free oral fluids

Data analysis was performed using SPSS for Windows, version 21 (SPSS Inc, Chicago, IL). Kolmogorov-Smirnov test was used to assess the distribution of data. Data were reported as mean±SD or frequencies (%) where applicable. Mean difference within the groups were compared by student *t* test. *p* value less than 0.05 was considered statistically significant. Categorical variables were analysed by chi-squared test.

RESULTS

A total of 150 patients were included in the study. Divided into two groups of 75 each. Two of the patients in ERAS group and one in conventional were dropped from the final analysis due to the conversion of their procedure to open cholecystectomy for various indications. There were no statistically significant differences in age, gender, patients with diabetes, BMI and ASA status between the groups. However, the number of smokers was greater in the ERAS group than in the conventional group. (Table-3)

Enhanced recovery after surgery group showed a statistically significant reduction in mean length of hospital stay 28.93±9.55 hours (mean±SD) in comparison to the conventional care group 40.54±11.00 ($p<0.01$). The direct per patient cost was shown to be reduced in the ERAS group PKR 6804±1032 vs Conventional care group PKR 7682±1422 ($p<0.05$). (Table-4) Results also demonstrated reduction in total opioid use in the ERAS group 11.4±3.7 morphine equivalent units vs 18.2±6.3 in the conventional care group ($p<0.01$). (Table-4)

Difference of Patient reported outcomes scores measured on SRS on discharge, day 3 of discharge and day 10 of discharge from the baseline score were calculated. There was no statistically significant difference found between the two groups. (Table-4) The rate of readmissions was 4% in ERAS group vs 8% in conventional group. ($p=0.312$). The rate of surgical site infections was 2.7% in ERAS group and 5.4% in conventional care group ($p=0.414$). These differences, however, were not statistically significant. (Table-5) There was no mortality in either group.

Flow Diagram

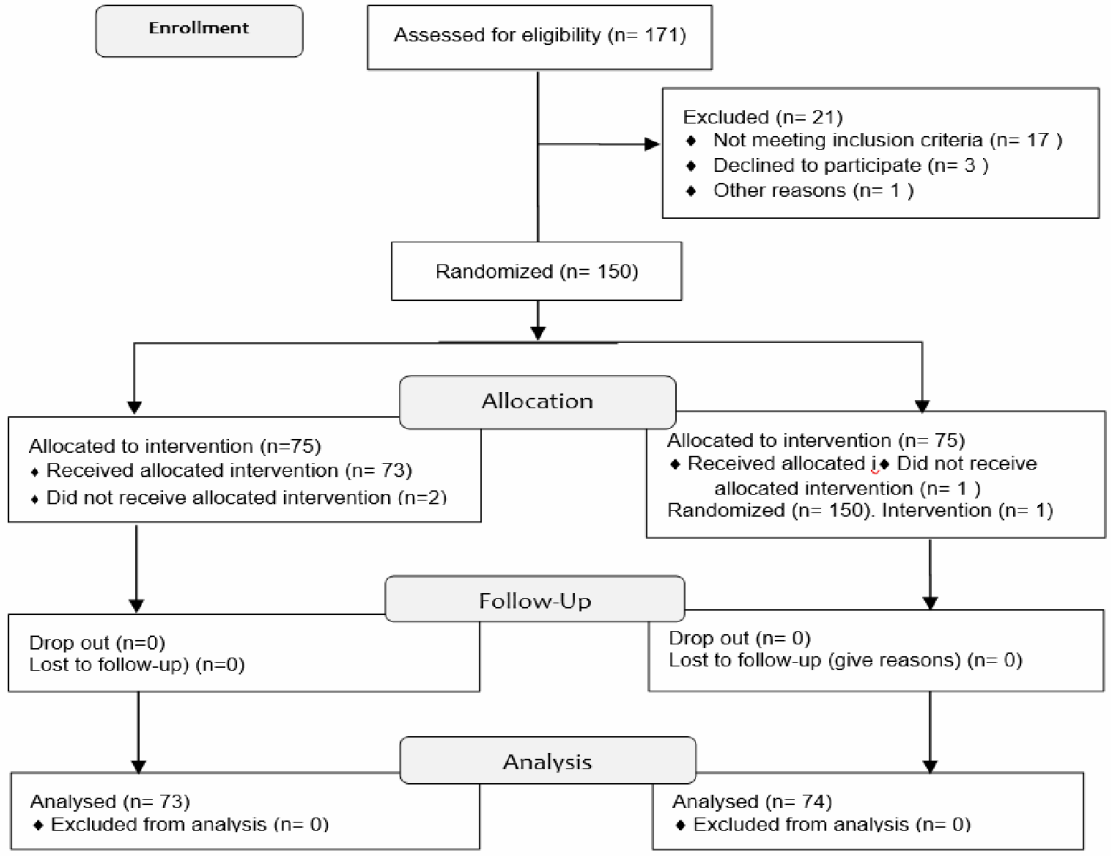

Table-1: Inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria	Drop out criteria:
• Age 18 to 70 • Indications: Gallbladder stones, polyp • Outpatient visit • Informed consent	• Age less than 18 • Acute Cholecystitis, gall bladder empyema • CBD stone • Visit via emergency • ASA 3 or greater • Biliary tract injury • Pulmonary disease • Previous operation history affecting laparoscopic surgery • OP complication; biliary tract injury	Less than 80% compliance Refuse discharge Conversion to Open cholecystectomy

Table-2: ERAS group vs conventional care group (Detailed ERAS recommendations[36])

ERAS group	Conventional group
PRE_OP • Day of surgery admission • Eras specific counselling • Normal meal at night+ Carbohydrate drinks x 2 (Galaxose-D) • Antibiotics at the time of induction **INTRA-OP** **Time of operation** • Preemptive nausea vomiting prophylaxis • No NG or Drain placement • Preemptive multimodal analgesia • Goal directed fluid use **POST OP** • Early feeding • Early mobilization • Opioid sparing multimodal analgesia • Early planned discharge after fulfilling discharge criteria.	**PRE_OP** • Day of surgery admission • Normal counselling • Overnight fast • Antibiotics at the time of induction. **INTRA-OP** **Time of operation** • Drain/NG by surgeons' preference • Analgesia as decided by care team. • Post op opioid analgesia when required. • Fluid use as decided by the care team **POST OP** • Feeding, mobilization and discharge as per conventional care and discharge criteria.

Table-3: Demographics

	ERAS Group (n-=73)	Conventional group (n=74)	*p**
Sex			
Male	33 (45%)	36 (48%)	0.676
Female	40 (54%)	38 (51%)	
Age	44.57±13.09	44.93±13.56	0.537
BMI	28.06±5.402	26.50±5.364	0.081
ASA Status			
I	66	67	
II	3	3	1.000
III	4	4	
Diabetic status	12 (16.4%)	11 (14.8%)	0.793

ASA = American Society of Anaesthesiologists physical status.
$p<.05$ was considered statistically significant.

Table-4: Outcomes. Mean±standard deviation

	ERAS Group (n-=73)	Conventional Group (n=74)	*p*
LOHS*	28.93±9.55	40.54±11.00	<0.001
Total cost (PKR)	6804±1032	7682±1422	<0.001
Total Opioid Use (Morphine equivalent units)	11.44±3.77	18.24±6.38	<0.001
SRS			
Baseline - SRS discharge	8.58±3.51	8.96±3,96	0.539
Baseline – SRS Day 3**	3.69±2.63	3.15±2.69	0.221
Baseline – SRS day 10***	0.97±2.74	0.78±2.05	0.632

*Length of hospital stay
**Surgical Recovery Scale score day 3 of discharge
***Surgical Recovery Scale score day 10 of discharge

Table-5: Outcomes

	ERAS Group (n-=73)	Conventional Group (n=74)	*p*
Readmissions	3 (4.1%)	6 (8.1%)	0.312
Surgical site infection	2 (2.7%)	4 (5.4%)	0.414

DISCUSSION

Over the past few decades, day case management of elective laparoscopic cholecystectomy has been widely accepted. This was made possible by reducing the most common post-operative problems like nausea vomiting and pain. Further studies showed that a faster discharge doesn't compromise quality of care, recovery and patient satisfaction.[32,33] Outpatient Laparoscopic cholecystectomy is associated with expected readmission rate of 5% and average discharge time of 6–8 hours.[34,35]

As Government funded Autonomous hospitals are the major healthcare providers in our country[24,25] these institutes operate under a fixed budget and fixed resources. To encounter the problem of ever-growing population of patients in limited resources, the hospitals are needed to provide efficient healthcare without compromising on the quality and patient satisfaction.

In our study, a trend toward lower length of hospital stay was noted in the ERAS group. 28.93±9.55 hours (mean±SD) in comparison to the conventional care group 40.54±11.00. The trend shown is similar to studies performed in ambulatory surgery with similar protocols. Calland *et al* reported that after implementation of these protocols, same-day discharges increased significantly, from 21–72% while no difference was found in patient satisfaction in both pre and post pathway groups.[32] Ahmad *et al* in a metanalysis attributed the reduction of length of stay to reduced post-operative nausea, vomiting, hematoma and adequate pain control.[33]

As expected, a decrease in length of stay decreased the total direct cost to the patient and hospital.[5] The direct per patient cost in the ERAS group vs Conventional care group shows a reduction of 12.9% in our study despite no significant difference in operative cost.

These results show the same trends shown by Chong JU *et al*. who reported a significant reduction of length of hospital stay from 2.51 days to just 1 day and reduction in all variables related to cost analysis.[28]

It can be argued that faster discharge can shift the inpatient burden to outpatient by sending the patients home earlier than appropriate. We used Surgical Recovery Scale scores to measure functional recovery. The two groups demonstrated no statistically significant difference highlighting the faster functional recovery in ERAS group. This together with no increase in readmission rate in the ERAS group makes enhanced recovery protocols in laparoscopic cholecystectomy not only feasible but preferred in our setup. ERAS can potentially provide more vacant beds and resources to process more patients in the same limited resources and help decrease the long waiting periods for elective surgery. As demonstrated by Calland *et al* the transition of Laparoscopic cholecystectomy to an outpatient procedure by these protocols resulted in the availability of an additional 89 bed-days during the course of a year.[32]

There is further room for improvement with more institutional experience and local adaptations. However, there are major cultural and realistic challenges to decreasing length of hospital stay in our setup. Our tertiary care hospital receives patients from far areas of the province that generally don't have a network of hospitals or even basic healthcare in some instances. Patients generally don't prefer leaving the hospital early after major procedures even after fulfilling discharge criteria due to cultural beliefs and concerns about having no nearby health facility in case of a major complication. Although preoperative counselling and involving the patient in the discharge plan before admission helped reduce

the anxiety, the effect may not be the same in a major operation.

Another limitation of our study was strict inclusion and exclusion criteria. Our patients were mostly healthy with fewer comorbid conditions. More data is needed across various local hospitals to accurately implement the set of guidelines in our setup. The cost estimates only include in-hospital pharmacy costs and disposables used during operation or ward care. It does not include the fixed resources like personnel costs or maintenance costs to the hospital.

An effort at institutional level is needed to organize and audit the process and facilitate the major changes needed for implementation of these guidelines.

CONCLUSION

Compared to conventional care, Enhanced recovery after surgery protocols showed significant reduction in length of hospital stay and total cost without increasing readmissions or changing patient reported outcome scores despite early discharge.

DISCLOSURE

The only costs in the course of this study were related to the telephone calls made to the patients on day 3 to fill a questionnaire. The costs were paid by equal contributions from the authors of this study.

AUTHORS' CONTRIBUTION

MSA: First author, study design, literature search, data collection, Analysis and interpretation. NK: Correspondence author, mentor, supervision. AQ: data analysis and interpretation. SZK: literature search, data collection

REFERENCES

1. Bainbridge D, Martin J, Arango M, Cheng D. Evidence-based Peri-operative Clinical Outcomes Research (EPiCOR) Group: Perioperative and anaesthetic-related mortality in developed and developing countries: A systematic review and metaanalysis. Lancet 2012;380(9847):1075–81.
2. Rowe MI, Rowe SA. The Last Fifty Years of Neonatal Surgical Management. Am J Surg 2000;180(5):345–50.
3. Varadhan KK, Neal KR, Dejong CH, Fearon KC, Ljungqvist O, Lobo DN. The enhanced recovery after surgery (ERAS) pathway for patients undergoing major elective open colorectal surgery: a meta-analysis of randomized controlled trials. Clin Nutr 2010;29(4):434–40.
4. Greco M, Capretti G, Beretta L, Gemma M, Pecorelli N, Braga M. Enhanced recovery program in colorectal surgery: a meta-analysis of randomized controlled trials. World J Surg 2014;38(6):1531–41.
5. Stephen AE, Berger DL. Shortened length of stay and hospital cost reduction with implementation of an accelerated clinical care pathway after elective colon resection. Surgery 2003;133(3):277–82.
6. Wind J, Hofland J, Preckel B, Hollmann MW, Bossuyt PM, Gouma DJ, *et al*. Perioperative strategy in colonic surgery; LAparoscopy and/or FAst track multimodal management versus standard care (LAFA trial). BMC Surg 2006;6(1):16.
7. Khoo CK, Vickery CJ, Forsyth N, Vinall NS, Eyre-Brook IA. A prospective randomized controlled trial of multimodal perioperative management protocol in patients undergoing elective colorectal resection for cancer. Ann Surg 2007;245(6):867.
8. Serclova Z, Dytrych P, Marvan J, Nova K, Hankeova Z, Ryska O, *et al*. Fast-track in open intestinal surgery: prospective randomized study (Clinical Trials Gov Identifier no. NCT00123456). Clin Nutr 2009;28(6):618–24.
9. Xiong J, Szatmary P, Huang W, de la Iglesia-Garcia D, Nunes QM, Xia Q, *et al*. "Enhanced Recovery After Surgery Program in Patients Undergoing Pancreaticoduodenectomy: A PRISMA-Compliant Systematic Review and Meta-Analysis." Medicine 2016;95(18):e3497.
10. Porter GA, Pisters PW, Mansyur C, Bisanz A, Reyna K, Stanford P, *et al*. Cost and utilization impact of a clinical pathway for patients undergoing pancreaticoduodenectomy. Ann Surg Oncol 2000;7(7):484–9.
11. Nikfarjam M, Weinberg L, Low N, Fink MA, Muralidharan V, Houli N, *et al*. A fast track recovery program significantly reduces hospital length of stay following uncomplicated pancreaticoduodenectomy. JOP. 2013;14(1):63–70.
12. Dickson E, Argenta PA, Reichert JA. Results of introducing a rapid recovery program for total abdominal hysterectomy. Gynecol Obstet Invest 2012;73(1):21–5.
13. Yoong W, Sivashanmugarajan V, Relph S, Bell A, Fajemirokun E, Davies T, *et al*. Can enhanced recovery pathways improve outcomes of vaginal hysterectomy? Cohort control study. J Minim Invasive Gynecol 2014;21(1):83–9.
14. Wijk L, Franzen K, Ljungqvist O, Nilsson K. Implementing a structured Enhanced Recovery After Surgery (ERAS) protocol reduces length of stay after abdominal hysterectomy. Acta Obstet Gynecol Scand 2014;93(8):749–56.
15. Ni CY, Yang Y, Chang YQ, Cai H, Xu B, Yang F, *et al*. Fast-track surgery improves postoperative recovery in patients undergoing partial hepatectomy for primary liver cancer: A prospective randomized controlled trial. Eur J Surg Oncol 2013;39(6):542–7.
16. He F, Lin X, Xie F, Huang Y, Yuan R. The effect of enhanced recovery program for patients undergoing partial laparoscopic hepatectomy of liver cancer. Clin Transl Oncol 2015;17(9):694–701.
17. Jones C, Kelliher L, Dickinson M, Riga A, Worthington T, Scott MJ, *et al*. Randomized clinical trial on enhanced recovery versus standard care following open liver resection. Br J Surg 2013;100(8):1015–24.
18. Hill AG, Hill GL. "Metabolic response to severe injury,". Br J Surg 1998;85(7):884–90.
19. Kehlet H. Multimodal approach to control postoperative pathophysiology and rehabilitation. Br J Anaesth 1997;78(5):606–17.
20. Ljungqvist O, Scott M, Fearon KC. Enhanced Recovery After SurgeryA Review. JAMA Surg 2017;152(3):292–8.
21. Ljungqvist O, Young-Fadok T, Demartines N. The History of Enhanced Recovery After Surgery and the ERAS Society. J Laparoendosc Adv Surg Tech A 2017;27(9):860–2.
22. Jung AD, Dhar VK, Hoehn RS, Atkinson SJ, Johnson BL, Rice T, *et al*. Enhanced Recovery after Colorectal Surgery: Can We Afford Not to Use It? J Am Coll Surg 2018;226(4):586–93.
23. Thiele RH, Rea KM, Turrentine FE, Friel CM, Hassinger TE, McMurry TL, *et al*. Standardization of care: impact of an enhanced recovery protocol on length of stay, complications, and direct costs after colorectal surgery. J Am Coll Surg 2015;220(4):430–43.
24. Mashhadi SF, Hamid S, Roshan R, Fawad A. Healthcare in pakistan–a systems perspective. Pak Armed Forces Med J 2016;66(1):136–42.

25. Meghani ST, Sehar S, Punjani NS. Comparison and analysis of health care delivery system: Pakistan versus CHINA. Int J Endorsing Health Sci Res 2014;2(1):46–9.
26. Lyon, A, Solomon, MJ, Harrison, JD. A qualitative study assessing the barriers to implementation of enhanced recovery after surgery. World J Surg 2014;38(6):1374–80.
27. Shamim M, Bano S, Iqbal SA. Pattern of cases and its management in a general surgery unit of a rural teaching institution. J Pak Med Assoc 2012;62(2):148–53.
28. Chong JU, Choi JB, Seo MA, Choi J, Lee SJ, Chen JH, *et al*. The Usefulness of Critical Pathway in Laparoscopic Cholecystectomy. J Minim Invasive Surg 2016;19(2):57–62.
29. Pakistan economic survey 2017-18. [Internet]. Economic Adviser's Wing, Finance Division, Government of Pakistan, Islamabad [Cited 2018 April 26]. Available from: http://www.finance.gov.pk/survey/chapters_18/Economic_Survey_2017_18.pdf
30. Paddison JS, Sammour T, Kahokehr A, Zargar-Shoshtari K, Hill AG. Development and validation of the Surgical Recovery Scale (SRS). J Surg Res 2011;167(2):e85–91
31. Bowyer AJ, Royse CF. Postoperative recovery and outcomes - what are we measuring and for whom? Anaesthesia 2016;71:72–7.
32. Calland JF, Tanaka K, Foley E, Bovbjerg VE, Markey DW, Blome S, *et al*. Outpatient laparoscopic cholecystectomy: patient outcomes after implementation of a clinical pathway. Ann Surg 2001;233(5):704–15.
33. Ahmad NZ, Byrnes G, Naqvi SA. A meta-analysis of ambulatory versus inpatient laparoscopic cholecystectomy. Surg Endo 2008;22(9):1928–34...
34. Johansson M, Thune A, Nelvin L, Lundell L. Randomized clinical trial of day-care versus overnight-stay laparoscopic cholecystectomy. Br J Surg 2006;93(1):639–40.
35. Kasem A, Paix A, Grandy-Smith S, El-Hasani S. Is laparoscopic cholecystectomy safe and acceptable as a day case procedure? J Laparoendosc Adv Surg Tech 2006;16(4):365–8.
36. Melloul E, Hubner M, Scott M, Snowden C, Prentis J, Dejong CH, *et al*. Guidelines for Perioperative Care for Liver Surgery: Enhanced Recovery After Surgery (ERAS) Society Recommendations. World J Surg 2016;40(10):2425–40.

Submitted: May 13, 2019	*Revised: June 16, 2019*	*Accepted: July 14, 2019*

Address for Correspondence:

Dr. Nadim khan. Professor of surgery, Department of Surgery, Lady reading hospital, Peshawar-Pakistan
Cell: +92 333 913 9005
Email: nadim_khan23@gmail.com