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Research Article

Recovery Profile Among Patients Undergoing Elective Laparoscopic Cholecystectomy Using the Modified Aldrete Score (MAS) and Fast-Track (FT) Criteria

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Abstract

Introduction: General anesthesia is considered safe for laparoscopic cholecystectomy because it allows for complete muscle relaxation and controlled ventilation, which are crucial for the procedure. Postoperative recovery assessment is crucial for patient safety and efficient operating room turnover. This study aimed to compare the post operative recovery profile among patients undergoing elective laparoscopic cholecystectomy using The Modified Aldrete Score (MAS) and Fast-Track (FT) Criteria. Materials and Methods: A prospective comparative study was conducted among 66 patients of either sex, ASA grade I &II. Recovery of group MAC (n=33) were assessed by Modified Aldrete Score and Recovery of group FTC (n=33) were assessed by Fast Track Criteria, who were randomly enrolled. Post operative recovery parameters were compared at intervals using MAS and FTC. Statistical analysis was computed using descriptive and inferential statistics. P-value of <0.05 was considered statistically significant. *Results:* Post-extubation recovery scores and nursing interventions were recorded every 5 min until 60 min and at 2, 6, 12 and 24 h in the post-operative period using both the criteria. As per MAS, the time for recovery (in minutes) was 16.36 ± 2.16, whereas for FTC was 17.88 ±1.38. Duration for surgery (in minutes) for MAS was 66.06 ±8.45, whereas for FTC was 72.36 ±13.38. There was not any statistical significance in pre-operative hemodynamic values, the number of nursing interventions before and after reaching time of recovery, and the dose of Fentanyl administered. *Conclusion:* The recovery profile of patients undergoing laparoscopic cholecystectomy under general anesthesia was faster when assessed by MAS than FTC in immediate post recovery period. Modified Aldrete scoring system is better than Fast track criteria as the discharge tool in Post Anesthesia Care Unit.

Keywords

FTC, MAS, PACU, Recovery Profile

1. Introduction

Postoperative recovery is a critical determinant of surgical outcomes, influencing patient satisfaction, hospital stay duration, and healthcare costs [1]. With the widespread adoption of minimally invasive techniques such as laparoscopic surgery, optimizing anesthesia management has become essential to facilitate faster recovery [2]. In low- and middle-income coun-

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tries (LMICs), the challenges associated with post-surgical recovery are more pronounced due to limited resources, inadequate healthcare infrastructure, and disparities in access to care. These regions often face higher post-operative mortality and morbidity rates compared to high-income countries [3].

The World Health Organization (WHO) and initiatives like the Lancet Commission on Global Surgery emphasize strengthening surgical systems, including pre-and post-operative care, but many LMICs continue to struggle with implementing standardized recovery protocols and managing post-operative complications effectively [4]. Although laparoscopic surgery offers benefits such as reduced tissue trauma and quicker return to normal function, it is not without challenges. Delivery of general anesthesia is associated with significant number of complications and One of the significant roles of an anesthesiologist is to provide safe anesthesia to the patient as well as address the complications that may occur [5].

There are a few recovery scales at the disposal of anesthesiologist to determine when post-anesthesia patients can be safely shifted from Post-anesthesia care Unit (PACU) to surgical ward or to second stage recovery area. Among them, the commonly used assess tools are Modified Aldrete Score and Fast Track Criteria [6]. The most popular criterion for determining recovery is MAS which takes into account the patients level of consciousness, vital signs and activity level [7].

Recovery is a continual and ongoing process that has been traditionally divided into three distinct yet overlapping phases often refers to as early recovery, as the patient emerges from anesthesia, the second is the period of intermediate recovery, during which the patient meets criteria for discharge, and the period of late recovery, during which the patient regains their preoperative physiological status [8]. In this stage patient regains power of coordination and dizziness disappears. This phase traditionally occurs in the post anesthesia care unit (PACU) in the presence of close monitoring and supervision by the nursing staff. MAS and FTC are used to determine when patients are fit for discharge from the PACU [9].

Late recovery or Long term recovery is when patient returns to their preoperative physiological state. In this state there is full recovery of coordination and higher intellectual function. Metabolism and elimination depends upon the adequacy of metabolizing enzymes and functional status organs responsible for it [10].

2. Material and Methods

This Prospective observational study was conducted in a post graduate private medical college with 752 bedded multi-speciality teaching hospital located at Birgunj Metropolitan of Parsa district of Central Nepal. After approval from Institutional Review Committee (Ref No - NMC/581/079-080) and informed written consent from 66 ASA I and II patients, ages 18 years and above of either sex under laparoscopic Cholecystectomy under General anesthesia during the period of (April 2023- March 2024) were included in this study. Exclusion criteria includes patient refusal, Patient aged >65 years, emergency surgery, surgery lasting more than 6 hours and patients requiring resuscitation following reversal. Sample size was calculated by taking prevalence of recovery in patients undergoing laparoscopic cholecystectomy for finite population.

Sample size for finite population = SS/[1+{(SS-1)/Population}] where, SS = Sample size for infinite population = Population of patients in the area/setting where the research will be done (here taken as 140 since National Medical College and Teaching Hospital gets patients who undergoes laparoscopic cholecystectomy of 140/year on average).

Sample size for finite population = 126/[1+{(126-1)/140}] = 66.46.

Patients underwent computer generated randomization using website randomizer.org and divided into two groups. Recovery of group MAC (n=33) were assessed by Modified Aldrete Score and Recovery of group FTC (n=33) were assessed by Fast Track Criteria.

After getting institutional and ethical clearance, pre-anesthetic workup of patients undergoing elective laparoscopic cholecystectomy was done one day prior to surgery. During pre-anesthetic visit, patient's, age, sex, co-morbidities, weight, and ASAPS classification were recorded. Patient's diagnosis and plan of surgery was recorded. Patients were examined for all systems and airway. Systolic blood pressure, diastolic blood pressure, mean arterial pressure, pulse rate and SpO2 was measured using mobile bedside patient monitor. Preoperative investigations were checked and regular drugs administered by patients were recorded. Patients were classified as per American society of anesthesiologist physical classification. After receiving the patient to operating suite, vitals monitor was attached, intravenous access was secured by 18 or 20 gauge IV catheter and RL infusion was started. Oxygenation was done with 100% oxygen at 6 L/min by circle system and face mask, which was followed by induction of general anesthesia. Induction was done with Fentanyl 1.5 mcg/kg IV, Propofol 2 mg/kg IV. Patients were ventilated by bag and mask of anesthesia workstation. Endotracheal intubation was done with appropriate sized cuffed endotracheal after neuromuscular blockade with Vecuronium 0.1 mg/kg IV. Duration of surgery was defined as time from skin incision to application of dressing after wound closure. After reaching the standard extubation criteria, patient was extubated, extubation time was recorded as 0 minute and patients were shifted to PACU. When patient arrived at PACU, patient's SpO2, pulse rate, SBP, DBP and MAP were. Recovery profile of group MAS was assessed by Modified Aldrete Score and recovery profile of group FTC was assessed by Fast Track Criteria. Post extubation MAS and FTC were recorded at 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55 and 60 minutes. Time of recovery was defined as time to attain MAS of 9 or more and FTC of 12 or more with no zero in any parameter. It was noted. Nursing interventions before and after time of recovery were noted. They were anti-emetics, analgesics, sedatives, oxygen therapy, vasopressors, Atropine, Na-

loxone, airway interventions, drugs to treat post anesthesia shivering. Airway interventions were head tilt, chin lift and oral/nasopharyngeal airways insertion. All these nursing interventions were counted in number and noted.

Out of 66 patients were included in the study, which were equally allocated in two groups. The recovery profile of first group (MAS) was analyzed using modified Aldrete scoring system, and the recovery profile of the second group (FTC) was analyzed using the Fast track criteria. Two groups were then compared for the socio-demographic variables, recovery profile and nursing interventions. Descriptive statistics (frequency, percentage, mean and standard deviation) and inferential statistics were used to analyze quantitative data. Pearson's Chi-square test and Student T-test were employed for intergroup comparison of categorical and numerical variables respectively. Multiple linear regression was done to examine factors associated with time of recovery. P-value of <0.05 was considered statistically significant and p value of <0.001 was considered very significant. Data presentation was done using tables and bar diagrams.

3. Results

The Mean age of patient for Group- MAS was 37.78±10.95, whereas for Group FTC was 37.76±10.55. Similarly, the mean weight for Group- MAS and Group FTC was 74.36±8.83 and 75.73±8.66 respectively. Majority 81.8% belong to ASA I category for both groups. Meanwhile, majority 81.8% had co-morbities in both groups. In both MAS and FTC group, female patients outnumbered male patients with female in MAS group being 72.7% and in FTC group 66.7%. The Mean age and weight of patient were compared using T-test and no any statistical significance was observed in between the groups (Table 1).

Table 1. *Distribution of patients according Socio-demographic anthropometric and comorbidity related variables (N=66).*

Characteristics	Group - MAS (n=33)	Group - FTC (n=33)	p-value
Age in years	37.78±10.95	37.76±10.55	0.825
Gender			
Male	9 (27.3%)	11 (33.3%)	0.592
Female	24 (72.7%)	22 (66.7%)	
Weight in Kg	74.36±8.83	75.73±8.66	0.529
ASA			
I	27 (81.8%)	27 (81.8%)	1.00
II	6 (18.2%)	6 (18.2%)	
No. Of co-morbidities			
0	27 (81.8%)	27 (8.1%)	1.00
1	4 (12.1%)	4 (12.1%)	
2	2 (6.1%)	2 (6.1%)	

Significant level at p<0.05

Table 2. *Mean distribution of post-operative hemodynamic values (N=66).*

Parameters	Group MAS (n=33)	Group FTC (n=33)	p-value
Pulse rate	76.55 ±12.91	82.00 ±13.59	0.100
Systolic blood pressure	125.94 ±15.08	122.82 ±15.76	0.414
Diastolic blood pressure	77.94 ±8.79	78.58 ±9.14	0.774
Mean arterial blood pressure	96.21 ±10.77	96.06 ±10.84	0.955
SpO2	96.94 ±1.11	97.06 ±1.36	0.695

Significant level at p<0.05

The above table demonstrates the mean scores of post-operative vital signs between two comparative groups. As per the comparison of the result obtained, mean score of pulse rate was found higher (82.00/min) in FTC group and SpO2 was obtained higher in MAS group (97.03%). Systolic blood pressure (125.94 mmHg) and mean arterial pressure (96.21 mmHg) were higher in MAS group while Diastolic blood pressure were higher in FTC group (78.58 mmHg). There was not any statistical significance in post-operative hemodynamic values between the MAS and FTC group (Table 2).

Table 3. *Comparative analysis of total Fentanyl doses, duration of surgery and recovery time (N=66).*

Parameter	Group MAS	Group FTC	p-value
Total Fentanyl dose (mcg/kg)	2.16 ±0.24	2..23 ±0.25	0.321
Duration of surgery	66.06 ±8.45	72.36 ±13.38	0.026
Recovery time	16.36 ±2.16	17.88 ±1.36	0.001
Pre recovery nursing interventions	1.30 ±0.505	1.52 ±0.566	0.139
Post recovery number of nursing interventions	1.39 ±0.659	1.24 ±0.663	0.355

Significant level at p<0.05

Total Fentanyl required for MAS group was 2.16±0.24 mcg/kg while FTC group was 2.23±0.25 mcg/kg. There was not any statistical difference between total Fentanyl dose in two groups (p-value: 0.321). Mean duration of surgery in MAS group was 66.06±8.45 while that of FTC group was 72.36±13.38. There was statistically significant difference in duration of surgery between MAS and FTC groups (*p-value: 0.026*). Time of recovery in the MAS group was 16.38±2.16 as compared to the FTC, 17.88±1.38. Despite very little difference clinically (1.52 minutes), it was statistically significant (*p-value: 0.001*). Number of nursing interventions before and after reaching time of recovery was not statistically significant (Table 3).

Table 4. *Multiple linear regression to assess factors associated with time of recovery Variables (N=66).*

Variables	B estimate (95% CI)	t	p-value
Group: FTC	0.627 (0.177, 1.076)	2.787	0.007
ASA: grade II	-0.721 (-1.282, -0.161)	-2.573	0.012
Duration of surgery (minutes)	0.141 (0.121, 0.161)	14.361	<0.001

Significant level at p<0.05, MAS was reference category for group and grade I was reference category for ASA.

Group, age, sex, weight, ASA, number of co-morbidities, all the preoperative vitals, the total Fentanyl dose and the duration of surgery were considered for multiple linear regression. Backward elimination method was used for the variable selection of optimal multiple linear regression model. Hence, group, ASA and duration of surgery were selected in the multiple linear regression model. All these three variables included in the model were significantly associated with time of recovery. The expected average increase in time of recovery in FTC group as compared to MAS group was found to be 0.627 minutes (B estimate: 0.627; 95% CI: 0.177, 1.076). The expected average decrease in time of recovery in patients with ASA II as compared to patients with ASA I was found to be 0.721 minutes (B estimate: -0.721; 95% CI: -1.282., -0.161). Each additional minute increase in duration of surgery is associated with an increase of 0.141 minutes in recovery time (B estimate: 0.141; 95% CI: 0.121, 0.161) (Table 4).

4. Discussion

The recovery of the patients after anesthesia and surgery is essential in maintaining stability and avoiding side effects [11]. Various assessment tools have been studied over the years to evaluate recovery and discharge of the patient from PACU. The MAS and FTC are commonly used and appeared

to be a better post operative recovery tool over the time based discharge methods [12]. Both MAS and FTC were found to be equally effective in evaluating recovery in immediate post operative period [13].

In our study there was statistically significant difference between time of recovery by using MAS≥ 9 and FTC≥ 12 among the patients. My null hypothesis was "There was statistically insignificant difference in recovery profile between FTC group and MAS group in Nepalese patients undergoing general anesthesia for elective laparoscopic cholecystectomy" which was based upon the time of recovery. Time of recovery in was 16.36±2.16 minutes while using MAS and 17.88±1.38 minutes while using FTC. Despite being clinically insignificant difference of 1.52 minutes, my study found this difference to be statistically significant (p value: 0.001). Hence, the null hypothesis was rejected by the findings.

Time of recovery for study subjects was shorter for the MAS group with 16.36±2.16 minutes while it was 17.88±1.38 minutes in the FTC group. These findings were comparable to the study [14] who also assessed time of recovery inpatients using MAS and DFTC in Desflurane, Sevoflurane and Propofol group and result revealed time of recovery when using MAS to be faster than FTC with 10.2 ±4.2 minutes in Desflurane group, 12.0±5.7 minutes in Sevoflurane group and 16.3±6.4 minutes with Propofol group while TOR when using FTC was 15.6±6.2 minutes in 12.0±5.7 minutes in Sevoflurane group and 16.3±6.4 minutes with Propofol group while TOR when using FTC was 15.6±6.2 minutes in Desflurane group, 16.4±6.9 minutes in the Sevoflurane group and 17.5±7.9 minutes in the Propofol group [15]. The time of recovery profile in their research and my research were similar but due to various differences in methodology including type of surgery and anesthesia techniques, we could not compare time duration of recovery.

The statistically significant difference between time of recovery by using MAS and FTC in my study (time difference 1.52 minutes, p-value 0.001) was similar to the study results from another similar study [13], where the mean time of recovery was 14.8+3.8 minutes for MAS (score ≥ 9) and 13±3.5 minutes for FTC (score ≥ 12) and despite the difference of 1.75 minutes it was found to be statistically significant (p=0.001, 95% CI 0.71; 2.78).

Our study included a post extubation assessment of patient for first hour after surgery at 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55 and 60 minutes. The first hour assessment of MAS and FTC score were nearly similar. The reason could be explained by the study [6] which suggested FTC could have additional patient-related benefits by taking into consideration PONV and pain but after 2- 4 hours following surgery. His study revealed increase in pain scores only after 1.5 hours after surgery that might be explained by the analgesic effect of anesthetic drugs administered in intra-operative period. The short duration of assessment could be a drawback for my study that shows MAS superior to FTC.

Our study showed MAS as a better post operative recovery tool compared to FTC based on time of recovery which was faster in MAS group (16.36+2.16 minutes) than FTC group (17.88+1.38 minutes). This findings were similar to study [12], whose finding revealed Modified Aldrete Score was (18.99 ± 21.76 min) and a median value of 15 min which was significantly shorter than the time of shifting using Fast-Track Criteria (187 ± 243.73 min) with a median value of 30 min. Another study [16] concluded that though fast track score has a higher weightage in terms of documentation of adequate recovery it also takes into consideration the Post- operative nausea and vomiting (PONV) and post-surgical pain.

In our study, a total of 66 patients undergoing laparoscopic cholecystectomy were observed for post operative recovery according to either MAS or the FTC criteria. 33 each patients were divided in two groups MAS group and FTC group. The demographic parameters age group, gender, weight, ASAPS, co-morbidities, preoperative hemodynamics were not significant in assessing time of recovery. The total dose of Fentanyl requirement was similar in both groups (2.14+0.24 mcg/kg for MAS and 2.23+0.25 mcg/kg for FTC) and majority of patients have no co-morbidities (81.8%) in both groups. So, total Fentanyl dose and co-morbidities were not significant for assessing time of recovery. The duration of surgery was the only factor that shows significance in assessing time of recovery.

The mean duration of surgery was 66.06+8.45 minutes in MAS group and 72.36+13.38 minutes in FTC group which was found to be statistically significant (p-value: 0.021) in my study. Time of recovery was significantly associated with duration of surgery (p-value < 0.026). The significance of association between time of recovery and duration of surgery could be due to statistical difference between duration of surgery between MAS and FTC group. This finding also establishes the correlation between time of recovery and duration of surgery, which was similar to another study [16]. The duration of surgery depends upon surgeons skills, surgeon assistants efficiency, adequacy of surgical window, all of which couldn't be standardized or modified for my research. In agreement to our findings, other studies [17-19].

Another study [20] reported a significant linear association between the prolonged duration of surgery and delayed time to recovery which is explained by the cumulative effect of the anesthetic drugs when surgeries are of long duration. Even after adjusting for confounding variables, the significant association between post operative recovery tool and time of recovery remained. This suggested that the type of post operative recovery tool may play a direct role in influencing time of recovery, independent of other patient characteristics. We also looked for any major intra-operative events but fortunately none occurred. None of our patients required Mephertermine, Esmolol, Atropine or resuscitation. We didn't need to send any patient to HDU or ICU. No any patient was excluded from the study due to development of major intra-operative events.

In PACU we considered Pethidine for shivering as nursing

intervention. None of our patient got violent requiring Benzodiazepine. This might be due to adequate analgesia with Fentanyl, Paracetamol and trunk block and meticulous intra-operative vitals. In our study we found that recovery was affected by duration of surgery. Among patient factors, factors affecting recovery are gender, old age, co-morbidities and body habitus. Our patients were not at extreme of age, very few had co-morbidities well under control and not at body habitus. Among drug factors Opioid use, volatile agent and fluid overload are major factors. In our study Fentanyl was used which is short acting, Isoflurane were used fixed at a dial of 1.2%. We avoided fluid overload by giving 20 ml/kg Ringers lactate to all patients. Among surgical and anesthetic factors, duration of surgery, hypoxia, hypotension, embolism and neuromuscular blockade primarily affect recovery. In our patients, none developed hypoxia, hypotension or embolism. We used Vecuronium for muscle relaxant which is intermediate acting and we reversed the neuromuscular blockade. Among metabolic factors none of our patient had hypo/hyperglycemia, hypo/hypernatremia, liver or renal failure, hypothermia or coagulation defects. None of our patients had delayed recovery due to above mentioned factors.

5. Conclusion

From the result of study, we can conclude that recovery profile of patients undergoing laparoscopic cholecystectomy under general anesthesia was faster when assessed by MAS than FTC in immediate post recovery period. Modified Aldrete scoring system is better than Fast track criteria as the discharge tool in PACU care. We recommend continuing MAS for recovery assessment in our setting.

Abbreviations

LMIC	Low Middle Income Countries
MAS	Modified Alfred Score
FTC	Fast Track Criteria
PACU	Post Anesthesia Care Unit

Author Contributions

Ramesh Ghimire: Conceptualization, Data curation, Formal Analysis, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Writing – original draft, Writing – review & editing

Aashish Pandey: Conceptualization, Data curation, Formal Analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing

Rupesh Mahato: Conceptualization, Investigation, Methodology, Project administration, Supervision, Validation, Writing – original draft, Writing – review & editing

Ethical Clearance

Following the standard procedure for ethical clearance, the study was conducted after the approval from institutional and ethical clearance (Ref No: NMC/581/079-080). Administrative approval to conduct the study was obtained from principal of National Medical College and Head of Department of Anesthesiology. Written Informed consent was taken from all the participants before data collection. The purpose of the study was clearly explained in an understandable language to the respondents. Participants were not forced to participate in the study if they were not willing to do so. No incentive or reward was given to the participants. Confidentiality was maintained throughout the study. Information obtained was used only for study purpose.

Conflicts of Interest

The authors declare no conflicts of interest.

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