Original Research

COMPARISON OF MODIFIED ALDRETE SCORE AND FAST-TRACK CRITERIA FOR ASSESSING RECOVERY AFTER GENERAL ANAESTHESIA IN LAPAROSCOPIC SURGERY: A PROSPECTIVE OBSERVATIONAL STUDY

Dr. Farhana Bashir[1], Dr. Syed Vaseem Aadil. K[2*], Dr. Naaz afrin[3], Dr. yasir wani[4]

[1]Assistant professor, Department of Anesthesiology and critical care government medical college Srinagar, Jammu and Kashmir, India.

[2]Resident, Department of Anesthesiology and critical care government medical college Srinagar, Jammu and Kashmir, India.

[3]MBBS, International Education College, jiangxi university of Chinese medicine. Nanchang, jiangxi province, china.

[4]Head Department of pediatrics, District Hospital Pulwama, Jammu and Kashmir, India.

Corresponding Author: Dr. Syed Vaseem Aadil. K

Assistant professor, Department of Anesthesiology and critical care government medical college Srinagar, Jammu and Kashmir, India

ABSTRACT

Background: Accurate assessment of recovery following general anaesthesia is essential for safe and timely discharge from the post-anaesthesia care unit (PACU). The Modified Aldrete Score (MAS) and Fast-Track Criteria (FTC) are widely used tools, but their comparative effectiveness in laparoscopic surgery remains uncertain.

Aim: To compare the Modified Aldrete Score and Fast-Track Criteria in assessing recovery and determining discharge readiness following general anaesthesia in patients undergoing laparoscopic surgery.

Methods: In this prospective observational study, 200 patients (ASA I–II) aged 18–65 years undergoing elective laparoscopic surgery under general anaesthesia were evaluated. Recovery was assessed using MAS and FTC at 5 minutes, 30 minutes, 2, 6, 12, and 24 hours post-extubation. Time to achieve discharge readiness (MAS ≥9, FTC ≥12), Visual Analogue Scale (VAS) scores, and agreement between the tools were analysed.

Results: At 5 minutes, 47.5% (MAS) and 46% (FTC) of patients were eligible for transfer, increasing to 94.5% and 90.5% at 30 minutes, and 100% in both groups by 2 hours. Mean time to discharge readiness was significantly shorter with MAS (23.1 ± 26.4 minutes) compared to FTC (27.1 ± 32.5 minutes; $p = 0.002$). Agreement between MAS and FTC was almost perfect at 5 minutes (kappa = 0.97) and substantial at 30 minutes (kappa = 0.71). MAS scores improved from 8.3 ± 0.6 at 5 minutes to 10 at 12 hours, while FTC scores increased from 11.3 ± 0.7 to 13.9 ± 0.1 over the same period. VAS scores decreased significantly from 6.2 ± 0.5 at 5 minutes to 1.2 ± 0.4 at 24 hours ($p < 0.001$). Antiemetics were required in 21.5% of patients, while all patients required rescue analgesia.

Conclusion: The Modified Aldrete Score enables earlier identification of discharge readiness, whereas Fast-Track Criteria provides a more comprehensive assessment by incorporating pain and postoperative nausea and vomiting. A combined or context-based approach may optimize postoperative recovery assessment and PACU discharge decisions.

Keywords: Modified Aldrete Score, Fast-Track Criteria, Pacu, Laparoscopic Surgery, Recovery, General Anaesthesia.

INTRODUCTION

An estimated 310 million surgeries are performed worldwide annually, and this number continues to increase (**1–2**).

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Advances in surgical and anaesthetic techniques have significantly improved perioperative care, with a focus on early recovery, patient safety, and reduced hospital stay (**3**).

Among these, laparoscopic surgery has become the standard of care for many procedures due to its advantages of reduced postoperative pain, faster recovery, minimal tissue trauma, and shorter hospitalization (**4–5**).

With its widespread adoption, optimizing postoperative recovery assessment has become increasingly important.

Recovery from anaesthesia is defined as the return of consciousness and awareness following cessation of anaesthetic agents (**6–7**).

It is a complex process influenced by factors such as anaesthetic technique, duration of surgery, patient co-morbidities, and intraoperative events (**6–7**). Recovery occurs in phases—immediate, intermediate, and long-term—and accurate assessment is essential to ensure safe discharge from the post-anaesthesia care unit (PACU) and to prevent complications (**6,8–10**). This is particularly important in resource-limited settings, where efficient utilization of PACU resources directly impacts patient care (**11–13**).

Several scoring systems are available to assess recovery following anaesthesia (**15–17**). The Modified Aldrete Score (MAS) is the most widely used tool, evaluating activity, respiration, circulation, consciousness, and oxygen saturation (**16,18–20**).

While MAS is simple and practical, it does not include assessment of postoperative pain and nausea, which are important determinants of recovery (**15,19–20**).

To overcome these limitations, the Fast-Track Criteria (FTC) was introduced, incorporating additional parameters such as pain and postoperative nausea and vomiting (**21**). FTC facilitates early transfer of selected patients from the operating room to step-down recovery areas, thereby reducing PACU stay and improving resource utilization (**21–23**).

However, laparoscopic surgeries pose unique challenges due to factors such as pneumoperitoneum-related physiological changes and variability in postoperative pain and nausea (**24–25**). Although both MAS and FTC are widely used, previous studies have shown variable results regarding their effectiveness in assessing recovery and discharge readiness (**19,20,26**).

Moreover, there is no universally accepted gold standard for recovery assessment. Inconsistent discharge practices may lead to delayed recovery detection, increased complications, and inefficient use of healthcare resources (**27–29**).

In the Indian setting, where laparoscopic surgeries are increasingly common, there is a need for reliable and practical recovery assessment tools (**30–31**). However, limited data exist comparing MAS and FTC specifically in laparoscopic procedures under general anaesthesia.

Therefore, the present study was undertaken to compare these two scoring systems in terms of recovery assessment and discharge readiness, with the aim of optimizing PACU management and improving patient outcomes.

MATERIALS AND METHODS

Study Design and Setting

This prospective comparative observational study was conducted in the Department of Anaesthesiology and Critical Care at a tertiary care teaching hospital over a period of 16 months.

Study Population

The study included 200 adult patients scheduled for elective laparoscopic surgery under general anaesthesia.

Inclusion Criteria

- Patients aged 18–65 years
- American Society of Anaesthesiologists (ASA) physical status I and II
- Patients undergoing elective laparoscopic procedures under general anaesthesia

Exclusion Criteria

- Pregnant patients
- Patients unable to comprehend the study protocol

Sampling Technique

A consecutive sampling method was employed to recruit eligible participants.

Ethical Considerations

Approval was obtained from the Institutional Ethics Committee prior to the commencement of the study. Written informed consent was obtained from all participants after explaining the study protocol.

Study Variables and Data Collection

Preoperative Assessment

All patients underwent a detailed pre-anaesthetic evaluation including:

- ASA grading
- Baseline haemodynamic parameters
- Assessment of co-morbidities

Intraoperative Data

The following intraoperative variables were recorded:

- Induction and intubation details
- Type of airway device used
- Duration of surgery (skin incision to closure)
- Use of opioids
- Time of extubation
- Intraoperative complications (if any)

Postoperative Assessment

Patients were shifted to the Post-Anaesthesia Care Unit (PACU) and assessed using:

- **Modified Aldrete Score (MAS)**
- **Fast-Track Criteria (FTC)**
- **Visual Analogue Scale (VAS)** for pain

Assessments were performed at:

- **5 minutes**
- **30 minutes**
- **2 hours**
- **6 hours**
- **12 hours**
- **24 hours** post-extubation

Outcome Measures

The primary outcomes included:

- Time to achieve discharge readiness:
  - **MAS ≥ 9**
  - **FTC ≥ 12**
- Proportion of patients eligible for transfer from PACU

Secondary outcomes included:

- Postoperative pain assessment using VAS

Requirement of rescue analgesics and antiemetics

- Agreement between MAS and FTC

Statistical Analysis

Data were entered into Microsoft Excel and analysed using IBM SPSS software. Quantitative variables were expressed as mean, standard deviation (SD), range, median, and interquartile range (IQR), **Qualitative variables** were expressed as frequency and percentage. The following statistical tests were applied:

- **Kappa statistics** to assess agreement between MAS and FTC
- **Mann–Whitney U test** and **Kruskal–Wallis test** for non-parametric data

A **p-value < 0.05** was considered statistically significant.

RESULTS

A total of 200 patients undergoing elective laparoscopic surgery under general anaesthesia were included in the study.

Baseline Characteristics

Table 1. Demographic Characteristics of Study Participants (N=200)

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	18–30	38	19
	31–45	59	29.5
	46–60	69	34.5
	>60	34	17
Gender	Male	75	37.5
	Female	125	62.5

The study population had a mean age of **45.9 ± 14.7 years**, with the majority belonging to the **46–60 years age group (34.5%)**. Females constituted **62.5%** of the study population.

Clinical Profile

Table 2. Clinical Characteristics of Study Participants (N=200)

Variable	Category	Frequency (n)	Percentage (%)
Co-morbidities	None	98	49
	Hypertension	26	13
	Diabetes Mellitus	6	3
	COPD/Asthma	4	2
	Thyroid disorders	10	5
	Multiple co-morbidities	49	24.5
	Others	7	3.5
Diagnosis	Gallstone disease	157	78.5
	Appendicitis	17	8.5
	Inguinal hernia	15	8
	Incisional hernia	5	2.5
	Supraumbilical hernia	5	2.5
ASA Status	ASA I	98	49
	ASA II	102	51
Type of Surgery	Cholecystectomy	158	79
	Mesh hernioplasty	23	11.5
	Appendicectomy	17	8.5
	Herniorrhaphy	1	0.5
	IPOM	1	0.5
Duration of Surgery	40–60 min	187	93.5
	60–80 min	13	6.5

Nearly half of the patients (**49%**) had no co-morbidities, while hypertension was the most common co-existing condition. The majority of patients underwent **laparoscopic cholecystectomy (79%)**, and most procedures were completed within **40–60 minutes (93.5%)**.

Baseline Haemodynamic Parameters

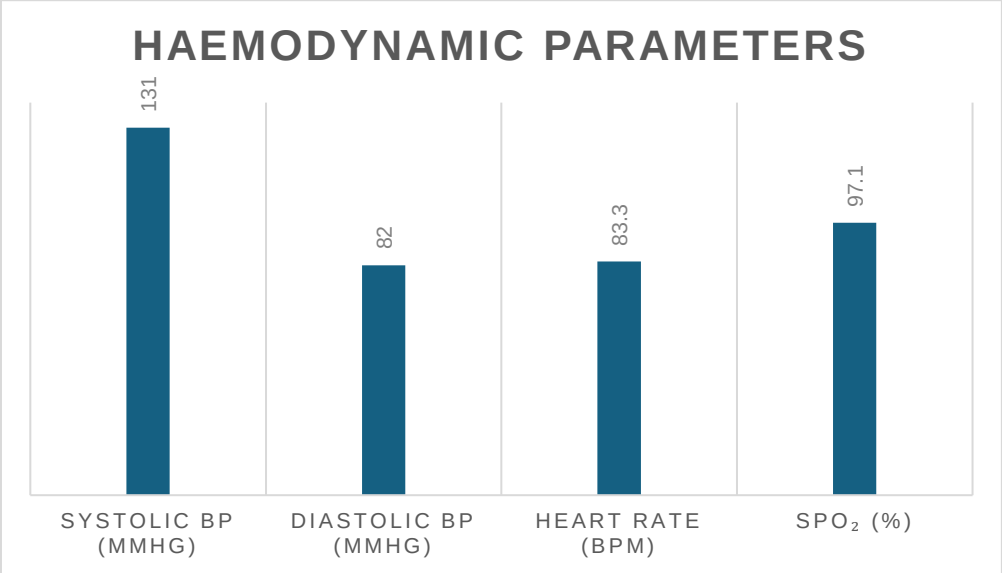

Figure 1. Baseline Haemodynamic Parameters

All patients had stable baseline haemodynamic parameters within normal physiological limits.

Recovery Profile

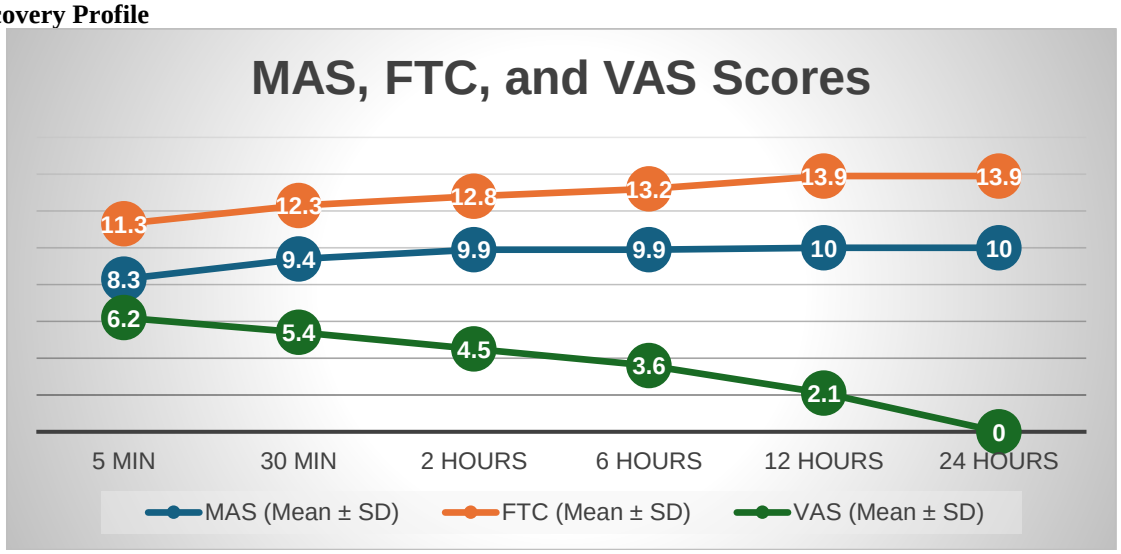

Figure 2. Distribution of MAS, FTC, and VAS Scores over Time

Both MAS and FTC scores showed a **progressive increase over time**, indicating steady recovery. Most patients achieved near-complete recovery within the **first 30 minutes**, with **complete recovery by 12 hours**.

Pain scores (VAS) demonstrated a **significant reduction over time ($p < 0.001$)**.

Eligibility for Transfer from PACU

Table 3. Proportion of Patients Eligible for Safe Transfer

Time	MAS ≥9 (%)	FTC ≥12 (%)
5 min	47.5	46
30 min	94.5	90.5
2 hours	100	100
6 hours	100	100
12 hours	100	100
24 hours	100	100

At 5 minutes, **47.5% (MAS)** and **46% (FTC)** of patients were eligible for transfer. This increased markedly by 30 minutes and reached **100% in both groups by 2 hours**, remaining consistent thereafter. MAS identified a slightly higher proportion of patients as ready for transfer in the early postoperative period.

Agreement between MAS and FTC

Table 4. Agreement Analysis between MAS and FTC

Time	Kappa value	Interpretation	P-value
5 min	0.970	Almost perfect	<0.001
30 min	0.713	Substantial	<0.001

There was **excellent agreement** between MAS and FTC in determining discharge readiness, particularly in the early postoperative period.

Time to Discharge Readiness

Table 5. Comparison of Time to Achieve Discharge Criteria

Tool	Mean ± SD (min)	Median (IQR)	Range
MAS ≥9	23.1 ± 26.4	30 (5–30)	5–120
FTC ≥12	27.1 ± 32.5	30 (5–60)	5–120

The mean time to achieve discharge readiness was **shorter with MAS (23.1 ± 26.4 minutes)** compared to **FTC (27.1 ± 32.5 minutes)**. This difference of approximately **4 minutes** was statistically significant (**p = 0.002**), indicating earlier identification of recovery using MAS.

Postoperative Medication Requirement

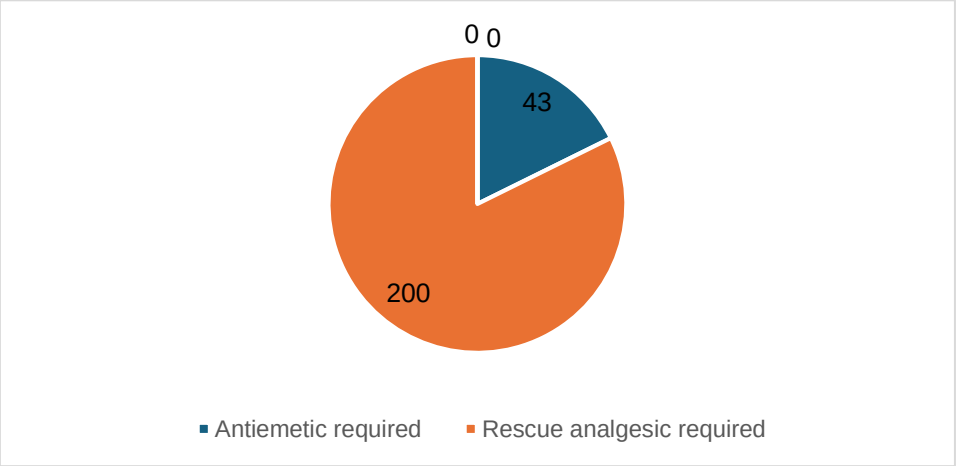

Figure 3. Analgesic and Antiemetic Requirement

All patients required rescue analgesia, while **21.5%** required antiemetic therapy during the postoperative period.

DISCUSSION

Laparoscopic surgery has become a standard surgical approach worldwide due to its advantages of faster recovery, reduced postoperative pain, and shorter hospital stay (**36**). With the increasing surgical burden, efficient utilization of post-anaesthesia care unit (PACU) resources and timely discharge assessment have become essential components of perioperative care (**37–39**). Standardized tools such as the Modified Aldrete Score (MAS) and Fast-Track Criteria (FTC) are widely used to guide recovery assessment and safe transfer of patients (**15**).

In the present study, the mean age was **45.9 ± 14.7 years**, with a female predominance (**62.5%**), and most patients underwent laparoscopic cholecystectomy (**79%**). This demographic pattern is consistent with the higher prevalence of gallstone disease among females, as reported by **Wang et al.** (**40**). Additionally, **51%** of patients had co-morbidities, mainly hypertension and thyroid disorders, which are known to influence perioperative recovery. Similar observations have been reported by **Kim et al.** (**41**) and **Park et al.** (**42**).

The Modified Aldrete Score showed a rapid improvement, increasing from **8.3 ± 0.6 at 5 minutes** to **10 at 12 hours**, with **47.5%** of patients achieving discharge readiness at 5 minutes and **94.5% at 30 minutes**. This reflects early

physiological stabilization following anaesthesia. Comparable findings were reported by **Ghimire et al.** (**35**), who demonstrated faster recovery detection using MAS compared to Fast-Track Criteria.

The Fast-Track Criteria also showed progressive improvement, with mean scores rising from **11.3 ± 0.7 at 5 minutes** to **13.9 ± 0.1 at 24 hours**. However, only **46%** of patients met FTC discharge criteria at 5 minutes and **90.5% at 30 minutes**, indicating slightly delayed recovery detection compared to MAS. This is likely due to inclusion of symptom-based parameters such as pain and postoperative nausea and vomiting (PONV). **White and Song** (**32**) similarly reported that although MAS identified discharge readiness earlier, patients required additional postoperative interventions when assessed using MAS alone.

In our study, the mean time to achieve discharge readiness was significantly shorter with MAS (**23.1 ± 26.4 minutes**) compared to FTC (**27.1 ± 32.5 minutes; p = 0.002**). These findings are in agreement with **Ghimire et al.** (**35**) and **Jain et al.** (**33**), who also demonstrated earlier recovery detection using MAS. However, FTC provides a more comprehensive assessment by incorporating patient comfort parameters. This observation is supported by **Saini et al.** (**34**), who concluded that MAS is efficient but less comprehensive compared to FTC.

Agreement between MAS and FTC in our study was **almost perfect at 5 minutes (κ = 0.97)** and **substantial at 30 minutes (κ = 0.71)**, with complete agreement after 2 hours. The slight variation during early recovery may be attributed to the presence of postoperative pain and nausea, which are not included in MAS. Pain scores were higher in the immediate postoperative period (VAS **6.2 ± 0.5 at 5 minutes**), consistent with the mechanisms described by **Shrestha et al.** (**43**) and **Kehlet et al.** (**44**), where laparoscopic pain is attributed to visceral irritation, pneumoperitoneum, and inflammatory responses.

Postoperative nausea and vomiting also contributed to delayed FTC recovery in some patients. These findings align with studies by **Zhou et al.** (**45**) and **Chen et al.** (**46**), which describe the role of inflammatory mediators and gastrointestinal stimulation in the pathophysiology of PONV.

Our results are further supported by **Jain et al.** (**33**), who demonstrated that criteria-based discharge using MAS and FTC reduces PACU stay compared to traditional time-based methods. However, **Burke and Kyker** (**31**) reported higher PACU bypass rates using FTC, highlighting its utility in ambulatory settings.

Overall, the present study demonstrates that while MAS allows **earlier identification of recovery**, FTC provides a **more comprehensive assessment** by incorporating pain and nausea. Both tools show strong agreement and clinical utility. A combined or context-based approach may provide optimal balance between efficiency and patient safety in PACU discharge decisions.

CONCLUSION

In this prospective observational study involving **200 patients** undergoing laparoscopic surgery under general anaesthesia, both the Modified Aldrete Score (MAS) and Fast-Track Criteria (FTC) were found to be effective tools for assessing postoperative recovery and determining discharge readiness from the PACU.

MAS demonstrated **earlier identification of recovery**, with a mean discharge readiness time of **23.1 ± 26.4 minutes**, compared to **27.1 ± 32.5 minutes** with FTC (**p = 0.002**). At 30 minutes, a higher proportion of patients were deemed fit for transfer using MAS (**94.5%**) compared to FTC (**90.5%**), although both tools showed **complete agreement (100%) by 2 hours**. Agreement between the two scoring systems was **almost perfect at 5 minutes (kappa = 0.97)** and **substantial at 30 minutes (kappa = 0.71)**.

Postoperative recovery showed a steady improvement, with MAS reaching a maximum score of **10 by 12 hours**, and FTC reaching **13.9 ± 0.1 by 24 hours**. Pain scores decreased significantly from **6.2 ± 0.5 at 5 minutes to 1.2 ± 0.4 at 24 hours (p < 0.001)**, while **21.5%** of patients required antiemetic therapy.

Overall, MAS is a **simple, efficient, and practical tool** for early identification of discharge readiness, particularly in high-volume and resource-limited settings. In contrast, FTC provides a **more comprehensive assessment** by incorporating postoperative pain and nausea, thereby enhancing detection of residual symptoms that may affect patient comfort and safety.

A **context-based or combined application** of both scoring systems may offer the most balanced approach, optimizing patient safety while ensuring efficient utilization of PACU resources.

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