

USEFULNESS OF ADDITIONAL PARAMETERS TO MEWS IN PREDICTING POSTOPERATIVE COMPLICATIONS AMONG PATIENTS UNDERGOING EMERGENCY LAPAROTOMY SURGERY

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ABSTRACT

Background: Emergency laparotomy is associated with substantial postoperative morbidity and mortality, making early recognition of physiological deterioration important. **Aim:** To compare the usefulness of adding intra-abdominal pressure (IAP) and intra-abdominal drain (IAD) parameters to the Modified Early Warning Score (MEWS) for postoperative risk stratification. **Materials and Methods:** A comparative cross-sectional study was conducted in the Department of General Surgery, Government Thoothukudi Medical College and Hospital, over 18 months. Sixty patients were included, with 30 assessed using MEWS alone and 30 using MEWS with IAP and IAD. Physiological variables, IAP, IAD characteristics, mortality and predefined postoperative complications were recorded. **Result:** Systolic blood pressure, urine output and neurological status were significantly associated with mortality ($p=0.024$, $p<0.001$ and $p=0.010$ respectively). IAP was also significantly associated with mortality ($p=0.002$), whereas IAD characteristics were not ($p=0.651$). On postoperative day 3, both MEWS and the combined MEWS+IAP+IAD score were significantly associated with mortality ($p<0.001$ for both); the combined score showed all recorded deaths in the highest score category. Surgical site infection was the most frequently recorded complication (5 of 30 patients, 16.7%). ICU stay did not differ significantly between the two scoring approaches ($p=0.373$). **Conclusion:** Addition of abdominal-specific observations to MEWS may provide a more comprehensive approach to postoperative risk stratification in emergency laparotomy. Prospective validation with formal diagnostic-performance analysis is required before routine adoption.

INTRODUCTION

Emergency laparotomy is undertaken for acute intra-abdominal conditions such as perforation, obstruction, bleeding and infection and is associated with substantial postoperative morbidity and mortality. Early recognition of physiological deterioration is therefore important for timely intervention, appropriate postoperative monitoring and escalation of care. The emergency surgical patient may deteriorate rapidly because of sepsis, circulatory compromise, organ dysfunction and the physiological stress associated with major abdominal surgery.^[1]

Early warning scores provide a structured approach to recognizing deterioration from routinely measured physiological variables. An automated risk-

assessment report built on this principle has been used to flag ward patients at risk of clinical deterioration, and a Cochrane review of outreach and early-warning systems examined their effect on intensive care admission and death in critically ill ward patients.^[1,2] The Modified Early Warning Score (MEWS) incorporates respiratory rate, heart rate, systolic blood pressure, temperature and level of consciousness into an aggregate score and has been validated in medical admissions.^[3] Related track-and-trigger systems have been evaluated systematically for identifying at-risk ward patients.^[4] refined into national early warning scores such as ViEWS.^[5] and shown to discriminate patients at risk of cardiac arrest, unplanned intensive care unit admission and death.^[6] However, MEWS reflects systemic physiological deterioration and was not

designed to capture abdominal-specific findings, so it may not fully represent the surgical and abdominal factors that contribute to adverse outcome after emergency laparotomy.

In emergency laparotomy, intra-abdominal hypertension may occur in association with bowel oedema, fluid administration, bleeding or abdominal sepsis and may be associated with organ dysfunction. Measurement of intra-abdominal pressure (IAP) has therefore been considered clinically relevant in critically ill surgical patients. A multicentre epidemiological study linked intra-abdominal hypertension to adverse outcome in mixed critically ill populations, an international expert conference produced recommendations for its standardised assessment, and updated consensus definitions and clinical practice guidelines have since been published.^[7-9]

Intra-abdominal drain (IAD) output may also provide information about the postoperative abdominal state, including changes in drainage character that may indicate bleeding or infection, and is a simple bedside observation already available in most patients managed with a drain after emergency laparotomy. Emergency general surgery patients represent a high-risk population, and a bedside score for this group needs to capture both systemic physiological deterioration and features specific to the operated abdomen.^[10] However, evidence on combining IAP and IAD with MEWS for postoperative risk stratification in emergency laparotomy is limited.

The present study therefore compared conventional MEWS assessment with an approach incorporating IAP and IAD, evaluating both the individual association of IAP and IAD with outcome and their combination with MEWS into a single augmented score, in patients undergoing emergency laparotomy. **Aim:** To compare the usefulness of additional parameters, IAP and IAD, with MEWS scoring for postoperative risk stratification among patients undergoing emergency laparotomy surgery.

MATERIALS AND METHODS

Study design and setting: This comparative cross-sectional study was conducted in the Department of General Surgery, Government Thoothukudi Medical College and Hospital, Thoothukudi, over a study duration of 18 months. Written informed consent was obtained from all study participants before enrolment, and the study was conducted with the guidance and approval of the Institutional Ethical Committee.

Study population and sample: Sixty patients undergoing emergency abdominal surgery were included. Thirty patients were assessed using MEWS alone (Group MEWS), and 30 patients were assessed using MEWS plus IAP and IAD (Group MEWS+IAP+IAD).

Inclusion and Exclusion criteria: Adult patients undergoing emergency abdominal surgery in the

Department of General Surgery at Government Thoothukudi Medical College and Hospital were included. Patients younger than 18 years and pregnant patients were excluded.

Methods: Data were collected prospectively from all eligible patients admitted with emergency surgical conditions and followed during the postoperative inpatient period. After obtaining informed consent, baseline demographic characteristics, including age and sex, and the emergency diagnosis were recorded in a structured proforma. Postoperatively, pulse rate, respiratory rate, temperature, systolic blood pressure, urine output and level of consciousness were monitored and documented. MEWS was calculated on postoperative day 3 using the standard physiological parameters, with each of the five core physiological variables assigned a score from 0 to 3 and the individual scores summed to obtain the aggregate MEWS. For analysis, MEWS was categorised as <3, 4–6 and 7–9. Patients were divided into the MEWS group and the combined MEWS+IAP+IAD group. In the MEWS+IAP+IAD group, IAP was additionally measured and categorised as 5–8, 12–15 and 16–20/21–25 mmHg, and IAD characteristics were assessed based on the nature of drain output and categorised as serous, serosanguinous/bloody, or pus/bile-fecal. The combined MEWS+IAP+IAD score was calculated on postoperative day 3 and categorised as <3, 4–6 and 7–9. Patients were followed throughout their hospital stay, and postoperative mortality was recorded as the primary outcome. Predefined postoperative complications, including surgical site infection, superficial venous thrombophlebitis, atelectasis of the lung and deep vein thrombosis, were documented. The duration of ICU stay was also recorded.

Statistical Analysis: Data were entered into Microsoft Excel and analysed using IBM SPSS Statistics v.25. Continuous variables were expressed as mean $\pm$ standard deviation (SD), while categorical variables were presented as frequencies and percentages. For comparison of continuous variables, the independent-samples t-test was used. Categorical variables were compared using the Pearson chi-square test or Fisher's exact test, as appropriate. A two-sided p-value <0.05 was considered statistically significant.

RESULTS

Sixty patients were included, with 30 in the MEWS group and 30 in the MEWS+IAP+IAD group. Detailed outcome comparisons were available for the combined-score group (n=30), in which 6 patients died and 24 were discharged to the ward. Mean age was similar between the death and ward groups (45.33 $\pm$ 10.27 vs 47.25 $\pm$ 10.82 years; p=0.698), and sex distribution did not differ significantly between groups (p=0.648) [Table 1]. The emergency diagnoses included irreducible and obstructed hernias, perforation peritonitis, gastric and duodenal perforation, adhesive small-bowel obstruction and

strangulated hernia with gangrenous ileal involvement.

Table 1: Demographic characteristics and postoperative outcome in the combined-score group

Variable	Death (n=6)	Ward (n=24)	p value
Mean age, years (mean $\pm$ SD)	45.33 $\pm$ 10.27	47.25 $\pm$ 10.82	0.698
Male, n (%)	3 (50.0%)	12 (50.0%)	0.648
Female, n (%)	3 (50.0%)	12 (50.0%)	

Legend: SD = standard deviation. p values compare death vs ward groups.

Among individual physiological parameters, systolic blood pressure ($p=0.024$), urine output ($p<0.001$) and neurological status ($p=0.010$) were significantly

associated with mortality. Heart rate, respiratory rate, temperature and oxygen supplementation were not significantly associated with mortality [Table 2].

Table 2: Association of individual physiological parameters with postoperative mortality

Parameter	Category	Death, n (%)	Ward, n (%)	p value
Systolic BP (mmHg)	81–100	3 (50.0%)	6 (25.0%)	0.024
	100–199	1 (16.7%)	17 (70.8%)	
	>200	2 (33.3%)	1 (4.2%)	
Urine output (mL/hour)	80–100	1 (16.7%)	0 (0.0%)	<0.001
	100–120	4 (66.7%)	1 (4.2%)	
	>120	1 (16.7%)	23 (95.8%)	
Neurological status	Alert	2 (33.3%)	21 (87.5%)	0.010
	Voice	3 (50.0%)	3 (12.5%)	
	Pain	1 (16.7%)	0 (0.0%)	
Heart rate (bpm)	51–100	3 (50.0%)	15 (62.5%)	0.660
	101–110	3 (50.0%)	9 (37.5%)	
Respiratory rate (/min)	9–14	2 (33.3%)	13 (54.2%)	0.651
	15–20	4 (66.7%)	11 (45.8%)	
Temperature ($^{\circ}$ C)	35.1–36	1 (16.7%)	0 (0.0%)	0.200
	36.1–38	5 (83.3%)	24 (100.0%)	
O2 supplementation	Yes	5 (83.3%)	14 (58.3%)	0.372
	No	1 (16.7%)	10 (41.7%)	

Legend: BP = blood pressure. Categories with zero patients in both groups (not shown) are omitted; percentages are of the death (n=6) or ward (n=24) group as appropriate.

IAD characteristics were not significantly associated with mortality ($p=0.651$); serous and serosanguinous/bloody drainage were the only recorded categories, with no patients recorded with

pus or bile-fecal drainage. IAP was significantly associated with mortality ($p=0.002$), with all six deaths occurring in the 12–15 mmHg category and none in the 5–8 mmHg category [Table 3].

Table 3: Association of intra-abdominal drain and intra-abdominal pressure characteristics with postoperative mortality (combined-score group, n=30)

Parameter	Category	Death, n (%)	Ward, n (%)	p value
IAD	Serous	4 (66.7%)	11 (45.8%)	0.651
	Serosanguinous/bloody	2 (33.3%)	13 (54.2%)	
	Pus/bile-fecal	0 (0.0%)	0 (0.0%)	
IAP (mmHg)	5–8	0 (0.0%)	18 (75.0%)	0.002
	12–15	6 (100.0%)	6 (25.0%)	
	16–20 / 21–25	0 (0.0%)	0 (0.0%)	

Legend: IAD = intra-abdominal drain; IAP = intra-abdominal pressure. Percentages are of the death (n=6) or ward (n=24) group as appropriate.

On postoperative day 3, MEWS was significantly associated with mortality ($p<0.001$): 4 deaths occurred in the 7–9 category and 2 in the 4–6 category, with none in the <3 category. For the combined MEWS+IAP+IAD score, all six deaths

occurred in the 7–9 category, with none below a score of 7 ($p<0.001$); mean scores were also higher among patients who died for both scoring approaches [Table 4].

Table 4: Postoperative day 3 (POD3) score categories and mortality in the combined-score group

Scoring approach	Score / comparison	Death, n (%)	Ward, n (%)	p value
MEWS	<3	0 (0.0%)	14 (58.3%)	<0.001
	4–6	2 (33.3%)	10 (41.7%)	
	7–9	4 (66.7%)	0 (0.0%)	
MEWS+IAP+IAD	<3	0 (0.0%)	6 (25.0%)	<0.001
	4–6	0 (0.0%)	17 (70.8%)	
	7–9	6 (100.0%)	1 (4.2%)	
Mean MEWS score (mean $\pm$ SD)	Death vs ward	7.01 $\pm$ 0.89	3.17 $\pm$ 1.68	<0.001
Mean MEWS+IAP+IAD score (mean $\pm$ SD)	Death vs ward	8.33 $\pm$ 0.82	4.21 $\pm$ 1.59	<0.001

Legend: MEWS = Modified Early Warning Score; IAP = intra-abdominal pressure; IAD = intra-abdominal drain; SD = standard deviation; POD3 = postoperative day 3. Mean-score rows report mean $\pm$ SD rather than n (%).

Postoperative complications recorded in the combined-score group (n=30) included surgical site infection, atelectasis of the lung, superficial venous thrombophlebitis and deep vein thrombosis; some patients experienced more than one complication. ICU stay did not differ significantly between the MEWS and MEWS+IAP+IAD groups (8.00 ± 1.55 vs 8.66 ± 0.82 days; $p=0.373$) [Table 5].

Table 5: Postoperative complications and ICU stay (combined-score group, n=30)

Outcome	Finding
Surgical site infection	5 (16.7%)
Atelectasis of lung	2 (6.7%)
Superficial venous thrombophlebitis	2 (6.7%)
Deep vein thrombosis	1 (3.3%)
Mean ICU stay, MEWS group (mean $\pm$ SD)	8.00 ± 1.55 days
Mean ICU stay, MEWS+IAP+IAD group (mean $\pm$ SD)	8.66 ± 0.82 days
Comparison of ICU stay	$p=0.373$ (not significant)

Legend: ICU = intensive care unit; SD = standard deviation; MEWS = Modified Early Warning Score; IAP = intra-abdominal pressure; IAD = intra-abdominal drain. Complication percentages are of the combined-score group (n=30); some patients had more than one complication.

DISCUSSION

The present study evaluated whether adding IAP and IAD to MEWS could provide additional information for postoperative risk stratification in emergency laparotomy. The principal findings were that higher MEWS values were associated with mortality, IAP was significantly associated with mortality, and the combined MEWS+IAP+IAD score showed all deaths concentrated in the highest score category on postoperative day 3; IAD characteristics alone were not significantly associated with mortality.

The mean age and sex distribution were comparable between patients who died and those who were discharged to the ward. Similarly, Patel et al. reported a mean age of 41.8 years, with 50.7% of patients being male, among 150 patients undergoing exploratory laparotomy.^[11] These findings indicate that age and sex were not significantly associated with mortality in the present study.

MEWS on postoperative day 3 was significantly associated with mortality ($p<0.001$). All six deaths had scores of 4 or more, with four in the 7–9 category and two in the 4–6 category. The mean MEWS was 7.01 ± 0.89 in the death group and 3.17 ± 1.68 in the ward group. Similarly, Patel et al. reported an overall mortality of 4% (6/150), and all six deaths occurred in patients with MEWS ≥ 7 ($p<0.001$).^[11] Li et al. evaluated 279 patients undergoing surgery for acute type A aortic dissection and found that MEWS was higher in patients who died at all postoperative time points. The highest predictive accuracy was observed at 12 hours, with an AUC of 0.758 at a cutoff of 4; the overall in-hospital mortality was 13.3%.^[12] Liu et al. reported an AUC of 0.944 for 90-day mortality, with an optimal cutoff of 4.5 (sensitivity 92.9%, specificity 82.0%).^[13] These findings are consistent with an association between higher postoperative MEWS and mortality across different surgical populations.

In our study, intra-abdominal pressure was significantly associated with mortality ($p=0.002$). All six deaths were in the 12–15 mmHg group, and none

were in the 5–8 mmHg group. Similarly, Smit et al. found that ICU and 90-day mortality rose with worsening pressure. They were 1.2% and 7.1% with normal pressure, 4.8% and 15.2% with intra-abdominal hypertension, and 16.7% and 38.9% with abdominal compartment syndrome.^[14] These findings are consistent with an association between higher IAP and mortality in the present study.

The character of intra-abdominal drain fluid was not associated with mortality ($p=0.651$). Serous drainage was seen in 66.7% of deaths and 45.8% of ward patients. Similarly, EuroSurg Collaborative evaluated 725 patients undergoing emergency colorectal surgery across 22 countries, with intraperitoneal drains placed in 53.7% of patients. After multivariable adjustment, drain placement was not significantly associated with reduced rates of postoperative intraperitoneal collections (OR=1.56, $p=0.457$) or earlier detection of collections (HR=1.07, $p=0.805$). Although the EuroSurg study assessed drain placement rather than drain-fluid characteristics, its findings provide related context for the absence of a significant association between IAD characteristics and mortality in our study.^[15]

The combined MEWS+IAP+IAD score placed all six deaths in the 7–9 category, with none below 7 ($p<0.001$). The mean combined score was 8.33 ± 0.82 in the death group and 4.21 ± 1.59 in the ward group. Darbyshire et al. suggest that integrating complementary clinical parameters may enhance postoperative risk stratification. Larger studies with formal comparisons of discrimination are needed to determine whether the combined MEWS+IAP+IAD score provides incremental predictive value over MEWS alone.¹⁶ Alhmoud et al. reported a mean AUC of 0.77 (95% CI 0.75–0.80) for mortality prediction across nine surgical studies of early warning scores.^[17] Whether combining these parameters improves mortality discrimination beyond MEWS alone requires confirmation in larger studies.

The available analysis does not establish the independent contribution of IAP or IAD after

adjustment for other variables. The present findings support further investigation of an augmented scoring approach but do not, by themselves, establish a validated clinical prediction rule. Larger prospective studies should use standardised and clearly reported statistical methods, evaluate the incremental value of IAP and IAD over MEWS, and report diagnostic performance with confidence intervals.

Limitations: The study had a small sample size, limited variability in several physiological and IAD categories, and a comparative cross-sectional design. Several strata contained few or no observations. The study does not report sensitivity, specificity, receiver operating characteristic analysis or confidence intervals, so the magnitude of predictive performance and incremental discrimination cannot be quantified from the available analysis, and the study does not establish independent associations after multivariable adjustment.

CONCLUSION

In patients undergoing emergency laparotomy, MEWS and abdominal-specific observations showed clinically relevant associations with postoperative mortality. Adding IAP and IAD may provide a more surgery-specific framework for postoperative risk stratification, but the current study does not establish formal predictive superiority. Larger prospective studies with standardised statistical analysis and diagnostic-performance assessment are required before routine clinical adoption.

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