

To Evaluate the Pre, Intra-Operative and Immediate Post-Operative Risk Factors Leading to Admission to ICU and Formulate Recommendations: An Institutional Based Study

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ABSTRACT

Background: ICU admissions may result from the primary disease, intra-operative factors, anticipated or unanticipated peri-operative complications or unrelated factors such as local hospital policy regarding admission of a sub-specialty. ICU management reduces the mortality and morbidity by 60%. The present prospective study was undertaken to evaluate the pre-, intra-operative and immediate post-operative risk factors leading to admission to ICU and formulate recommendations.

Materials and Methods: After the approval of Hospital Ethical Committee, the present study was conducted to evaluate all the post-operative admission in the Intensive Care Unit of a Tertiary Care Hospital for a period of one year (Nov 2013 and Nov 2014). All post-operative patients were divided into three groups: Group 1 – Informed Admissions, Group 2 – Uninformed Admissions, Group 3 – Post surgical Admissions. At the time of admission to ICU, Pre-operative evaluation, Operative variables, Post-operative variables and outcome of patients was studied. All the statistical analysis was performed using Statistical Package for Social Sciences (SPSS) version 20. A p value of <0.05 was considered significant.

Results: The results were as follows: A total of 341 patients were studied, out of them 61.6% were males and 38.4% were females. Out of the total patients admitted in the ICU post-operatively, most of these had planned surgery (76.2%). The incidence of unplanned admission to ICU in this study is 23%. The reason for unplanned admission to ICU in the current study is mainly for post-operative care following unanticipated intra-operative complications. Post-operative neurosurgical patients formed substantial percentage of the ICU admissions,

both planned and unplanned cases (168 out of 341;49.3%). The majority of post-operative cases (40%) had a length of stay ranging from 2-4 days. In planned admissions group, there were maximum patients of ASA II (44.0% of total post-operative admissions) while in unplanned post-operative admissions group, the maximum number of patients were of ASA III (12.6% of total post-operative ICU admissions). The mortality rate in this study is 8.5%.

Conclusion: This study concluded that post-operative surgical patients continue to make up a substantial proportion of ICU admissions in most hospitals. The cost of caring for ICU patients is very high and is estimated to be three to five times more than conventional ward care. Attention should, therefore, be directed to improving patient selection for ICU admission.

Keywords: ICU, Preoperative, Intraoperative, Post-Operative, Emergency.


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INTRODUCTION

The Intensive Care Unit (ICU) is a special unit primarily concerned with the care of patients with acute, recoverable, life-threatening, critical illness and injuries, which require constant close monitoring and support from specialized equipment and medications i.e., continuous artificial ventilation, vasopressors, inotropes, renal dialysis.¹ ICU beds are variously scaled. In the United States, up to 20% of hospital beds are labeled as intensive-care beds. In the United Kingdom, intensive care usually comprises only up to 2% of the total bed strength of a hospital. This high disparity is

attributed to the United Kingdom policy of admitting only the most severely ill. Generally in this country, ICUs are scaled at 8-10% of the total hospital beds; less than these are not considered economically viable and more than these have been proven to be less efficient.¹⁻³ However, there is a scarcity of evidence-based information about guidelines and standards for ICU triage after major surgery.² The multifactorial interaction of patient, anaesthesia and surgical variables determine overall patient risk.^{4,5}

Predictors of postoperative complications may be divided into three categories: known pre-operative risk factors; the risk associated with the specific surgical procedure; and the unique aspects of each operative case that may contribute to a particular patient being at high risk for mortality and morbidity after surgery.^{6,7} The American Society of Anaesthesiologists (ASA) Physical Status classification system is a scoring system commonly used in anaesthesia to assess the severity of the co-morbidities and indirectly, the requirement of a post-operative period of observation in the ICU.⁸⁻¹⁰ The reasons for unplanned ICU admission are multi-factorial occurring in the pre-, intra- and post-operative period being an amalgamation of inherent risk factors surrounding a combination of coincidences and even misjudgments in the peri-operative period. Many may be beyond the scope of the Anaesthesiologist's role in patient care.^{11,12} The present prospective study was undertaken to evaluate the pre-, intra-operative and immediate post-operative risk factors leading to admission to ICU and formulate recommendations.

MATERIALS AND METHODS

After the approval of Hospital Ethical Committee, the present study was conducted to evaluate all the post-operative admission in the Intensive Care Unit of a Tertiary Care Hospital for a period of one year. All post-operative patients were divided into three groups:

- Group 1: Informed Admissions: These patients were labeled the Planned Admission Group.
- Group 2: Uninformed Admissions: The group of such patients was labeled as Unplanned Admission Group.
- Group 3: Post-surgical Admissions: This includes those patients who were admitted to the ICU after forty-eight hours of the primary surgery for post-operative complications. These patients were labeled as Emergency Group.

Inclusion Criteria

1. All surgical patients admitted to ICU from Operating Room who needed intensive observation, management or monitoring in the post-operative period.
2. All patients who needed ICU care in view of unexpected peri-operative complications.
3. All patients with post-operative complications arising within forty-eight hours of primary surgery.

Exclusion Criteria

1. Patients already admitted to ICU for any other surgical/medical condition and who developed a surgical complication necessitating surgery

2. Paediatric cases (<12 years of age) in view of separate intensive care unit
3. Cardiac cases as these are routinely admitted to ICU post-operatively

As this was a study of usual care, no attempt was made to influence the treating Anaesthesiologist's about the choice of intra- or post-operative management.

Data Collection

Data of the patients was collected from all post-operative patients admitted between Nov 2013 and Nov 2014. At the time of admission to ICU, the following data were noted: demographic data, initial diagnosis, vital parameters, pre-operative and peri-operative variables were collected from patient's case sheet and anaesthesia case sheet. Additionally, various hemodynamic variables, duration of stay at ICU and outcome of the patients were noted. For analysis, the following factors were considered:

Pre-Operative Evaluation: This factor was studied with respect to demographic data which includes the following: Age and Sex of Patients, Prior Co-morbidities, Concurrent therapy, if any, Date of admission to ICU, Date of surgery, American Society of Anaesthesiologists' [ASA] physical status of the patient.

Operative Variables: This factor was studied with respect to the following: Anaesthesia technique, Surgical technique, Duration of Anaesthesia and Surgery, Nature of Surgery, Intra-operative problems like Hemoglobin Oxygen de-saturation (SpO2 <90%), Tachycardia (HR > 120 beats per minute for more than 10 minutes), Hypotension (Blood Pressure < 80 mm Hg for more than 15 minutes), Dys-arrhythmias, Difficult intubation, Pulmonary oedema, Major blood loss (more than 1000 ml blood loss).

Post-Operative Variables: This factor was studied with respect to the following: Nature of ICU admission, Complications and their management, Total length of stay in ICU.

Outcome of Patients: This factor was studied with respect to the following: Discharge or Death of the patients, Cause of death if the patient died.

Data Analysis

All the statistical analysis was performed using Statistical Package for Social Sciences (SPSS) version 20. The clinical profile of patients was analyzed by chi-square test for qualitative variables. Student 't'test was performed for comparison of quantitative variables. 5% probability level was considered as statistically significant i.e., a p value of <0.05 was considered significant. Results were expressed as the means and standard deviations, numbers and percentages. Quantitative independent sample t-test was used to calculate mean and standard deviation.

PREOPERATIVE VARIABLES

Table 1: Nature of Admission to ICU (Planned/Unplanned) * O₂ De-Saturation Room Air (SpO₂<90%)

| Nature of Admission to ICU (Planned/Unplanned) | Planned | Count | O ₂ Desaturation room air (SpO ₂ <90%) | | Total | P-value |
|--|---------|------------|--|------|--------|---------|
| | | | No | Yes | | |
| Planned | Count | 245 | 15 | 260 | 0.001 | |
| | | % of Total | 71.8% | 4.4% | | 76.2% |
| Unplanned | Count | 64 | 15 | 79 | 23.2% | |
| | | % of Total | 18.8% | 4.4% | | 23.2% |
| Emergency | Count | 2 | 0 | 2 | 0.6% | |
| | | % of Total | 0.6% | 0.0% | | 0.6% |
| Total | Count | 311 | 30 | 341 | 100.0% | |
| | | % of Total | 91.2% | 8.8% | | 100.0% |

Table 2: Nature of Admission to ICU (Planned/Unplanned) * H/O COPD With Cough & Shortness of Breath.

| Nature of Admission to ICU (Planned/Unplanned) | | Count | H/O COPD with cough and shortness of breath | | | Total | P-value |
|---|------------|-------|---|------------|------------|-------|---------|
| | | | No | Yes | Not Known | | |
| | | | % of Total | % of Total | % of Total | | |
| Planned | Count | 219 | 41 | 0 | 260 | 0.006 | |
| | % of Total | 64.2% | 12.0% | 0.0% | 76.2% | | |
| Unplanned | Count | 60 | 15 | 4 | 79 | | |
| | % of Total | 17.6% | 4.4% | 1.2% | 23.2% | | |
| Emergency | Count | 2 | 0 | 0 | 2 | | |
| | % of Total | 0.6% | 0.0% | 0.0% | 0.6% | | |
| Total | Count | 281 | 56 | 4 | 341 | | |
| | % of Total | 82.4% | 16.4% | 1.2% | 100.0% | | |

Table 3: Nature of Admission to ICU (Planned/Unplanned) * Renal Dis Creat > 1.4 mg/dl

| Nature of Admission to ICU (Planned/Unplanned) | | Count | Renal Disease Creat > 1.4 mg/dl | | Total | P-value |
|---|------------|-------|---------------------------------|------------|-------|---------|
| | | | No | Yes | | |
| | | | % of Total | % of Total | | |
| Planned | Count | 250 | 10 | 260 | 0.001 | |
| | % of Total | 73.3% | 2.93% | 76.2% | | |
| Unplanned | Count | 67 | 12 | 79 | | |
| | % of Total | 19.6% | 3.52% | 23.2% | | |
| Emergency | Count | 2 | 0 | 2 | | |
| | % of Total | 0.6% | 0.0% | 0.6% | | |
| Total | Count | 319 | 20 | 341 | | |
| | % of Total | 93.5% | 5.9% | 100% | | |

Table 4: Nature of Admission to ICU (Planned/Unplanned) *Cardiac Dis (Valve Lesion, Angina, Infarct)

| Nature of Admission to ICU (Planned/Unplanned) | | Count | Cardiac diseases (Valve Lesion, Angina, Infarct) | | | Total | P-value |
|---|------------|-------|--|------------|------------|-------|---------|
| | | | No | Yes | Not Known | | |
| | | | % of Total | % of Total | % of Total | | |
| Planned | Count | 235 | 24 | 1 | 260 | 0.002 | |
| | % of Total | 68.9% | 7.0% | 0.3% | 76.2% | | |
| Unplanned | Count | 61 | 13 | 5 | 79 | | |
| | % of Total | 17.9% | 3.8% | 1.5% | 23.2% | | |
| Emergency | Count | 2 | 0 | 0 | 2 | | |
| | % of Total | 0.6% | 0.0% | 0.0% | 0.6% | | |
| Total | Count | 298 | 37 | 6 | 341 | | |
| | % of Total | 87.4% | 10.9% | 1.8% | 100.0% | | |

Table 5: Nature of Admission to ICU (Planned/Unplanned) *HIV Status

| Nature of Admission to ICU (Planned/Unplanned) | | Count | HIV status | | Total | P-value |
|---|------------|-------|------------|------------|---------|---------|
| | | | Negative | Not Done | | |
| | | | % of Total | % of Total | | |
| Planned | Count | 250 | 10 | 260 | <0.0001 | |
| | % of Total | 73.3% | 2.9% | 76.2% | | |
| Unplanned | Count | 60 | 19 | 79 | | |
| | % of Total | 17.6% | 5.6% | 23.2% | | |
| Emergency | Count | 2 | 0 | 2 | | |
| | % of Total | 0.6% | 0.0% | 0.6% | | |
| Total | Count | 312 | 29 | 341 | | |
| | % of Total | 91.5% | 8.5% | 100.0% | | |

Table 6: Nature of Admission to ICU (Planned/Unplanned) * Other Illnesses (HTN, CVA, DM)

| Nature of Admission to ICU (Planned/Unplanned) | | Count | Other illnesses (HTN, CVA, DM) | | | Total | P-value |
|---|------------|-------|--------------------------------|------------|------------|--------|---------|
| | | | No | Yes | Not Known | | |
| | | | % of Total | % of Total | % of Total | | |
| Planned | Count | 137 | 122 | 1 | 260 | <0.001 | |
| | % of Total | 40.2% | 35.8% | 0.3% | 76.2% | | |
| Unplanned | Count | 24 | 46 | 9 | 79 | | |
| | % of Total | 7.0% | 13.5% | 2.6% | 23.2% | | |
| Emergency | Count | 2 | 0 | 0 | 2 | | |
| | % of Total | 0.6% | 0.0% | 0.0% | 0.6% | | |
| Total | Count | 163 | 168 | 10 | 341 | | |
| | % of Total | 47.8% | 49.3% | 2.9% | 100.0% | | |

Table 7: Nature of Admission to ICU (Planned/Unplanned) * ASA Physical Status

| Nature of Admission to ICU (Planned/Unplanned) | Planned | Count | ASA physical status | | | | Total | P-value |
|--|-----------|------------|---------------------|-------|-------|------|-------|---------|
| | | | I | II | III | IV | | |
| Planned | Planned | Count | 50 | 150 | 57 | 3 | 260 | <0.001 |
| | | % of Total | 14.7% | 44.0% | 16.7% | 0.9% | | |
| Unplanned | Unplanned | Count | 4 | 13 | 43 | 19 | 79 | |
| | | % of Total | 1.2% | 3.8% | 12.6% | 5.6% | | |
| Emergency | Emergency | Count | 1 | 1 | 0 | 0 | 2 | |
| | | % of Total | 0.3% | 0.3% | 0.0% | 0.0% | | |
| Total | Total | Count | 55 | 164 | 100 | 22 | 341 | |
| | | % of Total | 16.1% | 48.1% | 29.3% | 6.5% | | 100.0% |

RESULTS

The present study is a prospective evaluation study conducted on 341 patients who were admitted in the ICU of a tertiary care hospital from the operating room. On the basis of gender distribution more males were admitted in the ICU (61.6% in compare to 38.4% females) among the total ICU admissions within a year.

Preoperative Variables:

Oxygen de-saturation in planned, unplanned and emergency cases is 4.4%, 4.4% and 0.0% respectively. This is not significant with P-value of <0.001. (Table 1)

Patients admitted in ICU with H/O COPD preoperatively in planned, unplanned and emergency are significant with P-value of >0.001. (Table 2) Patients having known renal diseases preoperatively were admitted to ICU in the planned, unplanned

and emergency group were not significant with P-value of <0.001. (Table 3)

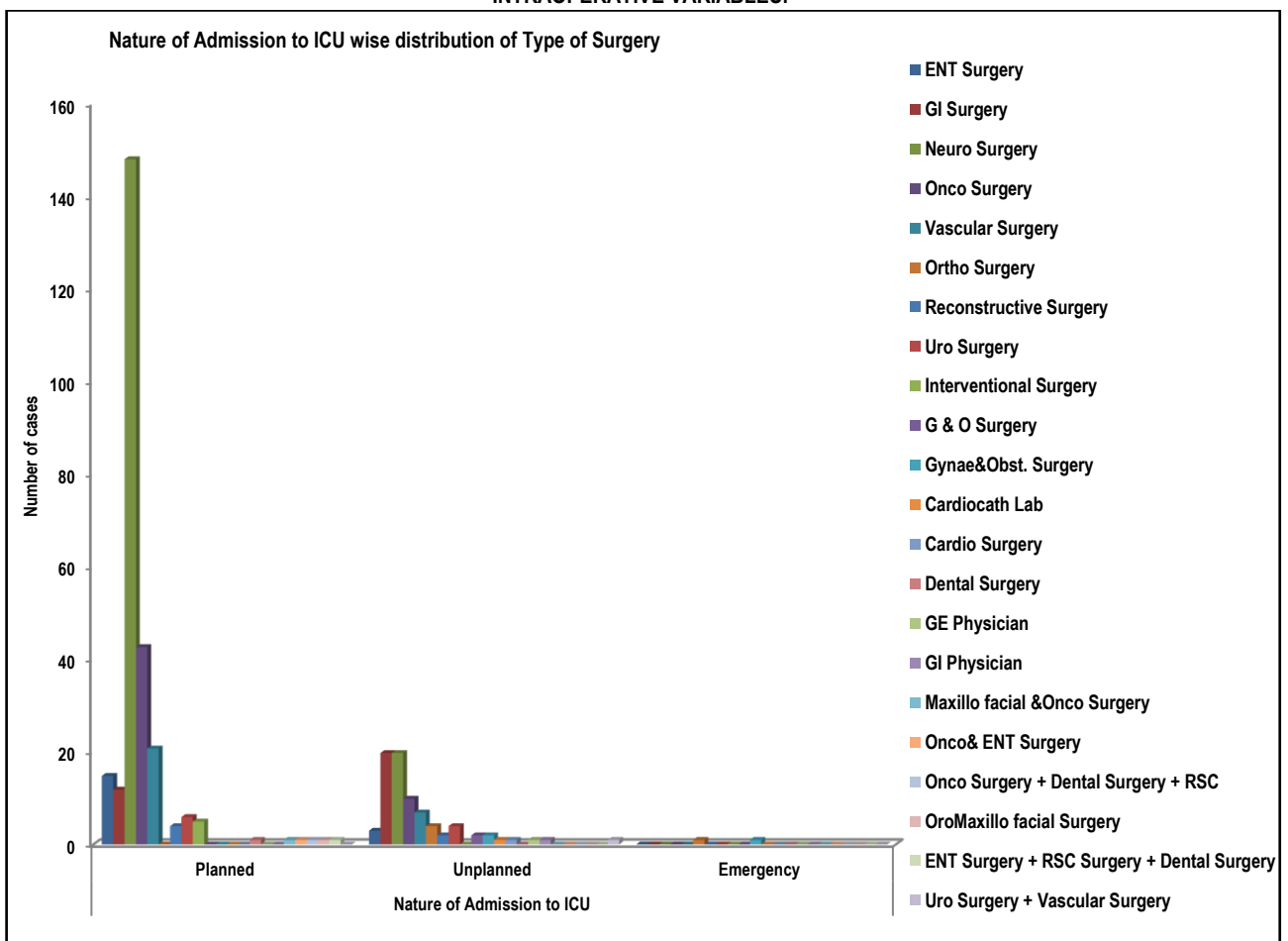
Patients, having cardiac disease prior to surgery, admitted to the ICU from the operating room, were significant in planned admissions unplanned and emergency cases respectively. This value is significant with P-value of >0.001. (Table 4)

In planned admissions and unplanned post-operative ICU admissions of HIV patients' value was not significant with P-value of <0.001. (Table 5)

Patients with other co-morbidities diagnosed pre-operatively were significantly more in planned ICU admission. This value is not significant with P-value of <0.001. (Table 6)

In planned admissions and unplanned admissions value was not significant with P-value of <0.001. (Table 7)

INTRAOPERATIVE VARIABLES:



Graph 1: Nature of Admission to ICU (Planned/Unplanned) * Type of Surgery

Table 8: Nature of Admission to ICU (Planned/Unplanned)* Anaesthesia Technique (GA/ RA/ Neurolept analgesia/LA)

| Nature of Admission to ICU (Planned/Unplanned) | Planned | Count | Anaesthesia Technique (GA/ RA/ Neurolept analgesia/LA) | | | | | | | | | | Total | P-value | |
|--|------------|-------|--|-----|-----|-----|-----|-----|-----|-----|-----|------|--------|---------|--------|
| | | | A | B | C | D | E | F | G | H | I | J | | | |
| Planned | Count | 2 | 252 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 260 | <0.001 | |
| | % of Total | 0.6 | 73.9 | 1.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 76.2 | | |
| Unplanned | Count | 0 | 63 | 3 | 5 | 1 | 3 | 1 | 1 | 1 | 1 | 79 | <0.001 | | |
| | % of Total | 0.0 | 18.5 | 0.9 | 1.5 | 0.3 | 0.9 | 0.3 | 0.3 | 0.3 | 0.3 | 23.2 | | | |
| Emergency | Count | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 2 | | | <0.001 |
| | % of Total | 0.0 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 0.0 | 0.6 | | | |
| Total | Count | 2 | 315 | 9 | 6 | 1 | 3 | 2 | 1 | 1 | 1 | 341 | | <0.001 | |
| | % of Total | 0.6 | 92.4 | 2.6 | 1.8 | 0.3 | 0.9 | 0.6 | 0.3 | 0.3 | 0.3 | 100 | | | |

A=GA with DLT; B=GA with ETT; C=LA + TIVA; D=Spinal Anaesthesia; E=RA; F=TIVA; G=Combined Spinal Epidural CSE; H=GA with I-GEL; I=Spinal Anaesthesia + GA with ETT; J=Spinal Anaesthesia with TIVA

Table 9: Nature of Admission to ICU (Planned/Unplanned) * Intra Operative O₂ De-Saturation (SPO₂ < 90 % for 10 min)

| Nature of Admission to ICU (Planned/Unplanned) | Planned | Count | Intra-Operative O ₂ desaturation (SPO ₂ < 90 % for 10 min) | | Total | P-value | | |
|--|------------|-------|--|------|--------|---------|--------|--------|
| | | | No | Yes | | | | |
| Planned | Count | 259 | 259 | 1 | 260 | <0.001 | | |
| | % of Total | 76.0% | 76.0% | 0.3% | 76.2% | | | |
| Unplanned | Count | 76 | 76 | 3 | 79 | | <0.001 | |
| | % of Total | 22.3% | 22.3% | 0.9% | 23.2% | | | |
| Emergency | Count | 2 | 2 | 0 | 2 | | | <0.001 |
| | % of Total | 0.6% | 0.6% | 0.0% | 0.6% | | | |
| Total | Count | 337 | 337 | 4 | 341 | <0.001 | | |
| | % of Total | 98.8% | 98.8% | 1.2% | 100.0% | | | |

Table 10: Nature of Admission to ICU (Planned/Unplanned) *Difficult Intubation (Two Or More Than Two Laryngoscopies)

| Nature of Admission to ICU (Planned/Unplanned) | Planned | Count | Difficult intubation (Two Or More Than Two Laryngoscopies) | | | | Total | P-value | | |
|--|------------|-------|--|-------|---------------|-------------------|-------|---------|--------|--------|
| | | | No | Yes | Not Intubated | Already Intubated | | | | |
| Planned | Count | 220 | 220 | 34 | 6 | 0 | 260 | <0.001 | | |
| | % of Total | 64.5% | 64.5% | 10.0% | 1.8% | 0.0% | 76.2% | | | |
| Unplanned | Count | 60 | 60 | 4 | 13 | 2 | 79 | | <0.001 | |
| | % of Total | 17.6% | 17.6% | 1.2% | 3.8% | 0.6% | 23.2% | | | |
| Emergency | Count | 0 | 0 | 0 | 2 | 0 | 2 | | | <0.001 |
| | % of Total | 0.0% | 0.0% | 0.0% | 0.6% | 0.0% | 0.6% | | | |
| Total | Count | 280 | 280 | 38 | 21 | 2 | 341 | <0.001 | | |
| | % of Total | 82.1% | 82.1% | 11.1% | 6.2% | 0.6% | 100% | | | |

Table 11: Nature of Admission to ICU (Planned/Unplanned) *Intra-Operative Tachycardia (HR > 120 for 10 min)

| Nature of Admission to ICU (Planned/Unplanned) | Planned | Count | Tachycardia (HR > 120 for 10 min) | | Total | P-value | | |
|--|------------|-------|-----------------------------------|-------|--------|---------|--------|--------|
| | | | No | Yes | | | | |
| Planned | Count | 241 | 241 | 19 | 260 | <0.001 | | |
| | % of Total | 70.7% | 70.7% | 5.6% | 76.2% | | | |
| Unplanned | Count | 51 | 51 | 28 | 79 | | <0.001 | |
| | % of Total | 15.0% | 15.0% | 8.2% | 23.2% | | | |
| Emergency | Count | 2 | 2 | 0 | 2 | | | <0.001 |
| | % of Total | 0.6% | 0.6% | 0.0% | 0.6% | | | |
| Total | Count | 294 | 294 | 47 | 341 | <0.001 | | |
| | % of Total | 86.2% | 86.2% | 13.8% | 100.0% | | | |

Table 12: Nature of Admission to ICU (Planned/Unplanned) *Intra-Operative Hypotension (SBP < 80 mm of Hg for 15 min)

| Nature of Admission to ICU (Planned/Unplanned) | Planned | Count | Hypotension (SBP < 80 mm of Hg for 15 min) | | Total | P-value | | |
|--|------------|-------|--|-------|--------|---------|--------|--------|
| | | | No | Yes | | | | |
| Planned | Count | 238 | 238 | 22 | 260 | <0.001 | | |
| | % of Total | 69.8% | 69.8% | 6.5% | 76.2% | | | |
| Unplanned | Count | 47 | 47 | 32 | 79 | | <0.001 | |
| | % of Total | 13.8% | 13.8% | 9.4% | 23.2% | | | |
| Emergency | Count | 2 | 2 | 0 | 2 | | | <0.001 |
| | % of Total | 0.6% | 0.6% | 0.0% | 0.6% | | | |
| Total | Count | 287 | 287 | 54 | 341 | <0.001 | | |
| | % of Total | 84.2% | 84.2% | 15.8% | 100.0% | | | |

Table 13: Nature of Admission to ICU (Planned/Unplanned)
***Intra-Operative Dys-Arrhythmias (New AF, SVT, Heart Block or Premature Ventricular Contraction>5 min)**

| Nature of Admission to ICU (Planned/Unplanned) | Planned | Count | Dys-arrhythmias (New AF, SVT, Heart Block or Premature Ventricular Contraction>5 min) | | Total | P-value |
|--|-----------|-------------------|---|------------|--------|---------|
| | | | No | Yes | | |
| | | | % of Total | % of Total | | |
| | | | 257 | 3 | 260 | 0.098 |
| | | | 75.4% | 0.9% | 76.2% | |
| | Unplanned | Count | 75 | 4 | 79 | |
| | | % of Total | 22.0% | 1.2% | 23.2% | |
| | Emergency | Count | 2 | 0 | 2 | |
| | | % of Total | 0.6% | 0.0% | 0.6% | |
| Total | | Count | 334 | 7 | 341 | |
| | | % of Total | 97.9% | 2.1% | 100.0% | |

Table 14: Nature of Admission to ICU (Planned/Unplanned) *Intra-Operative Major Blood Loss (>1000 ml)

| Nature of Admission to ICU (Planned/Unplanned) | Planned | Count | Major Blood Loss (>1000 ml) | | Total | P-value |
|--|-----------|-------------------|-----------------------------|------------|--------|---------|
| | | | No | Yes | | |
| | | | % of Total | % of Total | | |
| | | | 239 | 21 | 260 | 0.019 |
| | | | 70.1% | 6.2% | 76.2% | |
| | Unplanned | Count | 64 | 15 | 79 | |
| | | % of Total | 18.8% | 4.4% | 23.2% | |
| | Emergency | Count | 2 | 0 | 2 | |
| | | % of Total | 0.6% | 0.0% | 0.6% | |
| Total | | Count | 305 | 36 | 341 | |
| | | % of Total | 89.4% | 10.6% | 100.0% | |

Intraoperative Variables:

In planned ICU admissions and unplanned admissions, value was not significant with P-value of <0.001. (Graph 1)

General anaesthesia with endotracheal tube (ETT) was choice of anaesthesia in both 73.9% planned and 18.6% unplanned postoperative ICU admissions. This is not significant with P-value of <0.001. (Table 8)

There were a greater number of patients having O2 de-saturation intra-operatively in the unplanned group of ICU admissions (0.9%) as compared to the planned (0.3%) and emergency group (0.0%). This is not significant with P-value of <0.001. (Table 9)

There were a greater number of difficult intubations in planned ICU admission cases then unplanned and emergency. This value was not significant with P-value of <0.001. (Table 10)

In unplanned ICU admissions, 8.2% patients had intra-operative tachycardia and in planned admissions only 5.6% patients had tachycardia. This is not significant with P-value of <0.001. (Table 11)

Intra-operatively dys-arrythmias are seen more in unplanned admissions as compared to planned and emergency admissions to ICU. This was significant with P-value of >0.001. (Table 13)

Intra-operative major blood loss was significantly more in planned admissions as compared to unplanned and emergency, post-operative admissions to ICU. This was significant with P-value of >0.001. (Table 14)

Post-Operative Variables:

Out of total ICU admissions (341), only 5.9% (20) had post-operative Oxygen desaturation. This is not significant with P-value of <0.001. (Table 15)

34.0% patients of total post-operative planned ICU admissions were continued on ventilation in the ICU due to intra-operative complications. Out of these, 15.2% patients were of the and the 18.2% were of unplanned group. This was not significant with P-value of <0.001.

Patients, who were admitted to the ICU for post-operative observation, were significant as in planned admission group with compared to patients of unplanned admission group. Patients, who were not reversed due to intra-operative complications, were significant in emergency admission group as compared to unplanned admission group and planned admission group. This was significant with P-value of >0.001. (Table 16)

56.0% patients of total post-operative ICU admissions were able to sustain head for more than 5 sec. Out of these, 51.0% patients were of the planned ICU admission and 5.0% were of the unplanned ICU admission group. This was not significant with P-value of <0.001. (Table 17)

11.7% patients of unplanned post-operative ICU admissions had hypotension who were started on iono-tropic support. Among the planned post-operative ICU admissions 10.6% and 0.3% of emergency patients needed ionotropic support. This was not significant with P-value of <0.001. (Table 18)

In post-operative ICU admissions, tachycardia in unplanned post-operative ICU admissions 8.5% and in planned post-operative ICU admission 7.0%. This was not significant with P-value of <0.001. (Table 19)

Maximum number of hospital stay was 2-4 days of total post-operative ICU admissions. And minimum days for ICU stay was also significantly seen in planned ICU admissions. This was significant with P-value of >0.001. (Table 20)

From ICU, maximum patients were discharged to ward. Mostly patients who discharged to ward were of planned ICU admissions while 14.7% patients of total admission to ICU were discharged to ward after unplanned ICU admissions. This was not significant with P-value of <0.001. Patient, who were discharged to ward, significant in planned admission group 94.2% as compared to 63.3% unplanned and 50.0% patients of emergency admission group. Mortality was significant in emergency group. (Table 21)

POST-OPERATIVE VARIABLES:

Table 15: Nature of Admission to ICU (Planned/Unplanned) * SpO₂ (<90%)

| | | | SpO ₂ (<90%) | | Total | P-value |
|--|------------|------------|-------------------------|--------|-------|---------|
| | | | No | Yes | | |
| Nature of Admission to ICU (Planned/Unplanned) | Planned | Count | 253 | 7 | 260 | <0.001 |
| | | % of Total | 74.2% | 2.1% | 76.2% | |
| | Unplanned | Count | 68 | 11 | 79 | |
| | | % of Total | 19.9% | 3.2% | 23.2% | |
| | Emergency | Count | 0 | 2 | 2 | |
| | | % of Total | 0.0% | 0.6% | 0.6% | |
| Total | Count | 321 | 20 | 341 | | |
| | % of Total | 94.1% | 5.9% | 100.0% | | |

Table 16 A: Nature of Admission to ICU (Planned/Unplanned) *Causes of Post-Operative ICU Admissions

| | | | Causes of Post-operative ICU admissions | | | Total | P-value |
|--|------------|------------|---|---------------------|---|-------|---------|
| | | | Pre-planned postoperative Ventilation | Post Op observation | Not Reversed D/T intra-op complications | | |
| Nature of Admission to ICU (Planned/Unplanned) | Planned | Count | 34 | 174 | 52 | 260 | <0.001 |
| | | % of Total | 10.0% | 51.0% | 15.2% | 76.2% | |
| | Unplanned | Count | 0 | 17 | 62 | 79 | |
| | | % of Total | 0.0% | 5.0% | 18.2% | 23.2% | |
| | Emergency | Count | 0 | 0 | 2 | 2 | |
| | | % of Total | 0.0% | 0.0% | 0.6% | 0.6% | |
| Total | Count | 34 | 191 | 116 | 341 | | |
| | % of Total | 10.0% | 56.0% | 34.0% | 100.0% | | |

Table 16 B: Nature of Admission to ICU (Planned/Unplanned) *Group wise Causes of Post-Operative ICU Admissions

| | | | Group wise causes of postoperative ICU admissions | | | Total | P-value |
|--|-----------|------------|---|---------------------------|---|-------|---------|
| | | | Postoperative Ventilation | Postoperative observation | Not Reversed D/T intra-op complications | | |
| Nature of Admission to ICU (Planned/Unplanned) | Planned | Count | 34/260 | 174/260 | 52/260 | 260 | 0.098 |
| | | % of Total | 13.08% | 66.92% | 20.0% | | |
| | Unplanned | Count | 0 | 17/79 | 62/79 | 79 | |
| | | % of Total | 0.0% | 21.52% | 78.48% | | |
| | Emergency | Count | 0 | 0 | 2/2 | 2 | |
| | | % of Total | 0.0% | 0.0% | 100% | | |

Table 17: Nature of Admission to ICU (Planned/Unplanned) *Ability to Sustain Head Tilt> 5 sec

| | | | Ability to sustain head tilt > 5 sec | | Total | P-value |
|--|------------|------------|--------------------------------------|--------|-------|---------|
| | | | Yes | No | | |
| Nature of Admission to ICU (Planned/Unplanned) | Planned | Count | 174 | 86 | 260 | <0.001 |
| | | % of Total | 51.0% | 25.2% | 76.2% | |
| | Unplanned | Count | 17 | 62 | 79 | |
| | | % of Total | 5.0% | 18.2% | 23.2% | |
| | Emergency | Count | 0 | 2 | 2 | |
| | | % of Total | 0.0% | 0.6% | 0.6% | |
| Total | Count | 191 | 150 | 341 | | |
| | % of Total | 56.0% | 44.0% | 100.0% | | |

Table 18: Nature of Admission to ICU (Planned/Unplanned) * Hypotension (SBP<80 mm Hg) During ICU Stay

| | | | Hypotension (SBP<80 mm Hg) | | Total | P-value |
|--|------------|------------|----------------------------|--------|-------|---------|
| | | | No | Yes | | |
| Nature to Admission to ICU (Planned/Unplanned) | Planned | Count | 224 | 36 | 260 | <0.001 |
| | | % of Total | 65.7% | 10.6% | 76.2% | |
| | Unplanned | Count | 39 | 40 | 79 | |
| | | % of Total | 11.4% | 11.7% | 23.2% | |
| | Emergency | Count | 1 | 1 | 2 | |
| | | % of Total | 0.3% | 0.3% | 0.6% | |
| Total | Count | 264 | 77 | 341 | | |
| | % of Total | 77.4% | 22.6% | 100.0% | | |

Table 19: Nature of Admission to ICU (Planned/Unplanned) *Tachycardia (HR>120/min for more than 10 min) During ICU Stay

| | | | Tachycardia (HR>120/min for more than 10 min) | | Total | P-value |
|--|-----------|------------|---|-------|--------|---------|
| | | | No | Yes | | |
| Nature of Admission to ICU (Planned/Unplanned) | Planned | Count | 236 | 24 | 260 | <0.001 |
| | | % of Total | 69.2% | 7.0% | 76.2% | |
| | Unplanned | Count | 50 | 29 | 79 | |
| | | % of Total | 14.7% | 8.5% | 23.2% | |
| | Emergency | Count | 1 | 1 | 2 | |
| | | % of Total | 0.3% | 0.3% | 0.6% | |
| Total | | Count | 287 | 54 | 341 | |
| | | % of Total | 84.2% | 15.8% | 100.0% | |

Table 20: Nature of Admission to ICU (Planned/Unplanned) * Length of ICU Stay (<1 day/1-2 day/ 2-4 days/4-7 days/>7days)

| | | | Length of Stay at ICU (<1 day/1-2 days/ 2-4 days/ 4-7 days/>7 days) | | | | | Total | P-value |
|--|-----------|------------|---|----------|----------|----------|----------|--------|---------|
| | | | < 1 days | 1-2 days | 2-4 days | 4-7 days | > 7 days | | |
| | | | | | | | | | |
| Nature of Admission to ICU (Planned/Unplanned) | Planned | Count | 26 | 99 | 100 | 18 | 17 | 260 | 0.004 |
| | | % of Total | 7.6% | 29.0% | 29.3% | 5.3% | 5.0% | 76.2% | |
| | Unplanned | Count | 10 | 11 | 34 | 13 | 11 | 79 | |
| | | % of Total | 2.9% | 3.2% | 10.0% | 3.8% | 3.2% | 23.2% | |
| | Emergency | Count | 0 | 1 | 1 | 0 | 0 | 2 | |
| | | % of Total | 0.0% | 0.3% | 0.3% | 0.0% | 0.0% | 0.6% | |
| Total | | Count | 36 | 111 | 135 | 31 | 28 | 341 | |
| | | % of Total | 10.6% | 32.6% | 39.6% | 9.1% | 8.2% | 100.0% | |

Table 21 A: Nature of Admission to ICU (Planned/Unplanned) *Outcome of the Patients (Death /Discharge)

| | | | Outcome of patients (Discharge/ Death) | | Total | P-value |
|--|-----------|------------|--|--------------------|--------|---------|
| | | | Death | Discharged to ward | | |
| Nature of Admission at ICU (Planned/Unplanned) | Planned | Count | 15 | 245 | 260 | <0.001 |
| | | % of Total | 4.4% | 71.8% | 76.2% | |
| | Unplanned | Count | 29 | 50 | 79 | |
| | | % of Total | 8.5% | 14.7% | 23.2% | |
| | Emergency | Count | 1 | 1 | 2 | |
| | | % of Total | 0.3% | 0.3% | 0.6% | |
| Total | | Count | 45 | 296 | 341 | |
| | | % of Total | 13.2% | 86.8% | 100.0% | |

Table 21 B: Nature of Admission to ICU (Planned/Unplanned) *Group wise Outcome of the Patients (Death /Discharge)

| | | | Outcome of patients (group wise) | | Total | P-value |
|--|-----------|------------|----------------------------------|--------------------|-------|---------|
| | | | Death | Discharged to ward | | |
| Nature of Admission at ICU (Planned/Unplanned) | Planned | Count | 15/260 | 245/260 | 260 | <0.092 |
| | | % of Total | 5.8% | 94.2% | | |
| | Unplanned | Count | 29/79 | 50/79 | 79 | |
| | | % of Total | 36.7% | 63.3% | | |
| | Emergency | Count | 1/2 | 1/2 | 2 | |
| | | % of Total | 50.0% | 50.0% | | |
| Total | | Count | 45 | 296 | 341 | |

DISCUSSION

During the one-year period from Nov 2013 to Nov 2014, the total listed cases in Operation Theatre (OT) were 19,380 and unplanned or emergency cases were 2,208, making a total number of operated cases as 19,731. There was a total of 341 ICU admissions amongst the post-operative cases, making the incidence of post-operative ICU admissions as 1.72%.

In the present study, of total post-operative ICU admissions, 73.3% (250) patients were HIV negative in planned post-operative admissions group and 17.6% (60), 0.6% (2) patients in unplanned and emergency admission group respectively. The overall percentage was 91.5% among the patients tested. Okoye O and

colleagues reported a 96.3% prevalence of HIV negative patients.¹³

In this study, there is nearly equal distribution of post-operative ICU admissions in patients with and without other co-morbidities (hypertension, Diabetes Mellitus, Cerebro-Vascular Accident, thyroid disorder and others) taken collectively (49.3% and 47.8% respectively). Israeli Consensus Guidelines recommend ICU admission for all postoperative vascular or major general surgery patients with severe underlying systemic disease.^{14,15}

Regarding the pre-operative ASA Class of the post-operative patients admitted to the ICU, ASA II has formed a substantial

percent of the patients with 48.1%, 29.3%, in ASA III, 16.1% in ASA I and 6.5% in ASA IV. Two trauma-focused studies evaluating 7,724¹⁶ and 1,090¹⁷ patients respectively concluded that ASA III patients form a statistically significant percent of patients requiring post-operative ICU observation.

In this study, 18.5% patients of total post-operative ICU admissions were following emergency and unplanned surgeries and 81.5% patients (278 out of 341 of total postoperative ICU admissions) were of planned surgeries. It is quite different from the observations of other authors who reported an incidence of 70% emergency procedures while 30% elective procedures.¹⁶

In this study it was observed that maximum post-operative admissions were neuro-surgery (49.3%). This observation is different with other studies where 74.5% of the total number of post-operative intensive care unit admissions had undergone abdominal surgery.^{18,19}

In the current study, the technique of anaesthesia in 317 (93.0%) of the 341 patients admitted to the Intensive Care Unit in the post-operative period was general anaesthesia with endotracheal tube (ETT). This is correlated by the study of Satyawan et al where 95.6% patients operated GA with ETT admitted to the ICU.¹⁸

In this study it was observed that the mean duration of anaesthesia in planned ICU admission (i.e., 76.25% of the total) was 305.95 mins and 186.86 mins for unplanned admissions (22.87% of the total). Several studies have demonstrated greater peri-operative risk with increase in the duration of surgery and hence the duration of anaesthesia. Nevertheless, the risk predictive value of this factor is questionable.²⁰

In the present study, it was observed that intra-operative oxygen de-saturation ($SpO_2 \leq 90\%$ for minimum 10 min) occurred in 0.9% cases of unplanned cases while in planned cases only 0.3% had an intra-operative dip in saturation. On this issue not much previous data is available.

Michel and colleagues analyzed the various pre-operative factors which could lead to intra-operative oxygen de-saturation in ambulatory patients. They compared pre-operative and post-operative SpO_2 in ambulatory patients and found a 1-2% difference in patients with increased BMI and preoperative respiratory disorders.²¹

Out of the total of 341 postoperative ICU admissions in the current study, 11.1% (38/341) had difficult intubation, 82.1% had no documented difficult intubation while 6.2% were not intubated. 0.6% patients of the total post-operative ICU admissions were already intubated pre-operatively. Unanticipated difficult airway, a common clinical problem encountered by all anesthesiologists, is probably the most important cause of major anesthesia-related morbidity.²²

In the present study, it was observed that 15.8% (54 out of 341 of total postoperative ICU admissions) cases had intra-operative hypotension and 13.8% cases had tachycardia. Relatively little is known about the influence of intra-operative hemodynamic variables on surgical outcomes. But the incidence correlates with the study by David L et al, who had an incidence rate of 11.8% tachycardia and 20% hypotension intra-operatively.²³

In the present study, it was observed that 10.6% patients had major blood loss (>1000 ml) intra-operatively. In their study of 298 patients, Mojtaba Miri et al observed that 39.9% required an intra-operative red cell transfusion.²⁴

In this study it was found that in unplanned ICU admissions, 18.2% (62 out of 341) cases were not reversed and had multiple intra-operative surgical and anaesthetic factors like long duration of surgery, change of plan of surgery, intra-operative hemodynamic instability, difficult extubation, post-operative oxygen de-saturation ($SpO_2 < 90\%$) and failed reversal. This result correlates with the study of Satyawan AB and colleagues who stated that there are 13.2% contributory reasons for unplanned ICU admissions.¹⁸

Post-operative oxygen de-saturation was found in 5.9% (20 out of 341) patients. Out of 79 unplanned cases, there were 11 (3.2%) had post-operative oxygen de-saturation, 20.8% patients were unable to sustain head tilt and 11.7% patients had hypotension and tachycardia in the PACU. Keith Rose and colleagues however observed that main unplanned ICU admissions are mainly due to respiratory events.¹²

There are not many studies directly linking the incidence of post-operative hypotension or tachycardia in the PACU with incidence of post-operative ICU admission.

In the present study, it was found that 22.6% (77/341) patients had hypotension and 15.8% (54/341) had tachycardia during ICU stay. Out of which 10.6% (36/341) of planned admissions and 11.7% of unplanned admissions had hypotension and tachycardia during ICU stay. This observation is corroborated with the study by James K and colleagues who reported an incidence of 22% hypotension and 7.5% abnormal heart rate in post-operative patients.²⁵

In the present study, not any case of pulmonary oedema was observed as intra-operative complication neither during the post-operative ICU stay. Literature is scarce, directly linking intra-operative complications causing pulmonary oedema. James R and colleagues observed the incidence of postoperative pulmonary oedema more in younger or pediatrics patients.²⁶

There is wide variation in the length of stay of the post-operative patients in ICU. In the current study, the length of ICU stay of 2-4 days is 39.6% of 341 (total ICU admissions). This correlates with the study of Jacobson T et al who observed the lengths of intensive care and hospital stay as 4.4 days.²⁷

It has been observed that long term outcomes of patients in the term of 28 days mortality, length of stay and incidence of adverse events were worse for the unplanned than for the planned post-operative group.²⁸

CONCLUSION

Post-operative surgical patients continue to make up a substantial proportion of ICU admissions in most hospitals. The cost of caring for ICU patients is very high and is estimated to be three to five times more than conventional ward care. Attention should, therefore, be directed to improving patient selection for ICU admission.

LIMITATIONS

It is a single center study. Moreover, the center itself is a tertiary care referral hospital which may not allow generalization to the other centers. The period of study was also one year, which is too small to get a general trend. However, the data can serve as a baseline data for comparison between centers and also in the future to assess if there are any changes in the trends of unplanned admissions to ICUs.

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