

ICU Utilization by Cardio-Thoracic Patients in a Nigerian Teaching Hospital: Any Role for HDU?

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ABSTRACT

Background: The underlying pathological conditions in cardio-thoracic patients, anesthetic and operative interventions often lead to complex physiological interactions that necessitate ICU care. Our objectives were to determine the intensive care unit (ICU) utilization by cardio-thoracic patients in our centre, highlight the common indications for admission; and evaluate the interventions provided in the ICU and the factors that determined outcome. **Materials and Methods:** The intensive care unit (ICU) records of University College Hospital, Ibadan for a period of 2 years (October 2007 to September 2009) were reviewed. Data of cardio-thoracic patients were extracted and used for analysis. Information obtained included the patient demographics, indications for admission, interventions offered in the ICU and the outcome. **Results:** A total of 1, 207 patients were managed in the ICU and 206 cardio-thoracic procedures were carried out during the study period. However, only 96 patients were admitted into the ICU following cardio-thoracic procedures, accounting for 7.9% of ICU admissions and 46.6% of cardio-thoracic procedures done within the review period. The mean length of stay and ventilation were 5.71 ± 5.26 and 1.30 ± 2.62 days. The most significant predictor of outcome was endotracheal intubation ($P = 0.001$) and overall mortality was 15%. **Conclusion:** There is a high utilization of the ICU by cardio-thoracic patients in our review and post-operative care was the main indication for admission. Some selected cases may be managed in the HDU to reduce the burden on ICU resources. We opine that when endotracheal intubation is to continue in the ICU, a 1:1 patient ratio should be instituted.

KEYWORDS: Cardio-thoracic surgery, hospital, intensive care unit, Nigeria, teaching, utilization

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The high cost of the ICU care and interventions makes a strong case for establishing a database of patients treated in each ICU; These databases can be analyzed taking into account the case mix and severity of illness to provide information on resource utilization in relation to outcome and also direct comparisons of outcome between units. In an effort to limit ICU costs and to improve the efficiency of hospital resources, two complementary strategies have been proposed: (1) implementation of strict admission and discharge criteria to ICUs, by selecting patients who will most benefit from high-quality intensive care;^[1] and (2) opening of intermediate care units to enable earlier discharge from ICUs and to free ICU beds for the most seriously ill patients.^[2-5]

Our objectives were to: (1) Determine intensive care unit (ICU) utilization by cardio-thoracic patients in our centre; (2) Highlight common indications for admission; and (3) Evaluate interventions provided in the ICU and factors that determined outcome.

INTRODUCTION

Intensive care has become a standard component of postoperative treatment for most patients who undergo cardio-thoracic procedures. This is often necessitated by the complex physiological interactions resulting from underlying patient's pathological conditions and co-morbidities, as well as anesthetic and operative interventions. The post-operative care usually extends beyond the immediate post-extubation period to ensure adequate monitoring for potential complications. These complications may include hypotension, hypertension, depressed cardiac output, arterial and ventricular arrhythmias, and bleeding from chest tubes.

MATERIALS AND METHODS

The intensive care unit (ICU) records of the University College Hospital, Ibadan from October 2007 to September 2009 were reviewed. Data of cardio-thoracic patients were extracted and used for analysis. Information obtained included the patient's demographics, indications for admission, interventions offered in the ICU and outcome. Our ICU consists of 12-beds and admits medical, obstetric and surgical patients. Three (3) consultant anaesthetists take turn to cover the ICU between 8.00 am and 4.00 pm every week, after which the consultant anaesthetist on-call takes over. A senior registrar in anaesthesia is assigned to the ICU every month and 2 to 3 registrars every

week. The nurse-patient ratio averages 1: 2. Our bed occupancy per time is about 70%.

Analysis

All variables were expressed as number of cases/percentages or means with standard deviations. Variables considered included age, gender, diagnosis, indications for admission, length of stay, whether endotracheal intubation was in place on arrival in the ICU, ventilatory therapy, surgical tracheostomy, inootherapy, central venous pressure (CVP) monitoring and number of days on the ventilator. Standard statistical software SPSS version 17.0 was utilized for all data analysis. Statistical significance was defined as a probability value <0.05.

RESULTS

A total of 1, 207 patients were managed in the ICU and 206 cardio-thoracic procedures were carried out during the study period. However, only 96 patients were admitted into the ICU following cardio-thoracic procedures, accounting for 7.9% of ICU admissions and 46.6% of cardio-thoracic procedures done within the review period. The male:female ratio was 1:1.2. To allow for a proper study of the spectrum of diseases, the ages were classified into 7 groups; below 30 days, 30 days to 1 year, above 1 year to 5 years, above 5 years to 10 years, above 10 years to 20 years, above 20 years to 40 years and above 40 years to 60 years. Patients between 20 years and 60 years accounted for 53%. The mean length of stay was 5.71 ± 5.26 days [Table 1]. The main indication for admission was routine post-operative care in 83 (86.4%) patients [Figure 1] and 37 patients (38.5%) had endotracheal intubation as part of the treatment modality in the ICU. Four (80%) of the 5 patients with Tetralogy of Fallot that had Blallock-Taussig shunt and all (100%) the 3 patients with tracheoesophageal fistula that had a one-stage repair admitted into the ICU had ventilatory support as part of their management and

none of them survived [Table 2]. The mean length of stay and ventilation were 5.71 ± 5.26 and 1.30 ± 2.62 days, respectively.

The most significant predictor of outcome was endotracheal intubation ($P = 0.001$) [Table 3] and overall mortality was 15%.

DISCUSSION

Our review showed a high ICU utilization by cardio-thoracic patients, especially following operative procedures. This is not a surprise since most of these patients required a highly specialized care that will provide for early identification and intervention in the event of sudden deterioration in clinical status. It is not unlikely that some of these patients may require a level of care available in the high dependency unit (HDU) or post-anesthesia care unit (PACU) with 24-h coverage; this will make room for judicious utilization of resources available in the ICU. In the study by Schweizer *et al.*,^[6] following opening of a new PACU (with 24-h coverage) there was a marked reduction in ICU utilization after elective major non-cardiac surgery. Admission rates in the ICU decreased from 35% to 16% following vascular surgery and from 57% to less than 2% following thoracic surgery. No negative impact on the quality of care was associated with this shift from ICU to PACU utilization. Another study^[7] comparing elective care in the ICU, post anesthesia care unit (PACU), or dedicated intermediate care/step down unit (SDU) among cardiac and pulmonary patients showed a decreasing trend in total morbidity, but no change in mortality rate; however, the overall hospital costs were markedly increased with the daily cost being highest during the first 3 days in the ICU. With an average ventilation days in our review being two days, some of our patients could also have been managed in the HDU if we had one.

Also, a case can be made for a dedicated cardiothoracic ICU in view of the relatively high ICU utilization in our review, especially since care in a focused ICU have been associated with improved outcome compared to that in a non-focused ICU.^[8-10] Lott *et al.*^[11] also found that the risk-adjusted mortality for patients admitted to non-ideal specialty units was much higher.

In our review, gender and age does not seem to affect the pattern of admission and outcome. However, Roche *et al.*^[12] in a

Table 1: Admission characteristics of cardiothoracic patients in the ICU of UCH Ibadan between October 2007-September 2009

	N (%)	Mean±SD
Sex		
Male	52 (54.2)	
Female	44 (45.8)	
Age		
Below 30 days	6 (6.3)	
>30 days to 1 year	6 (6.3)	
> 1 year to 5 years	13 (13.5)	
>5 years to 10 years	5 (5.2)	
>10 years to 20 years	13 (13.5)	
>20 years to 40 years	17 (17.7)	
>40 years to 60 years	18 (18.8)	
>60 years	18 (18.8)	
Days on Ventilator		1.30±0.62
LOS (days)		5.71±5.26
Mortality	15 (15.6)	

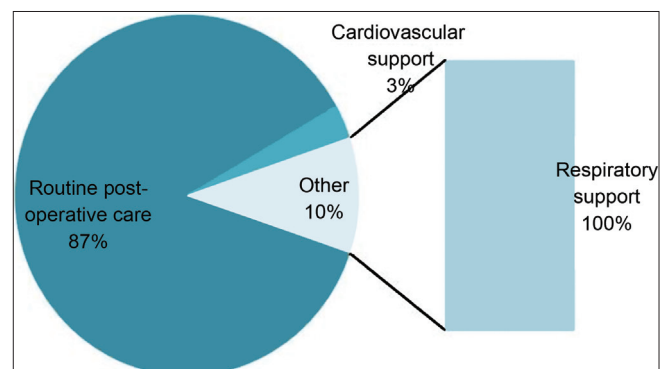


Figure 1: Indications for admission in cardiothoracic patients admitted into the ICU of UCH between October 2007 and September 2009

Table 2: Diagnosis/Ventilatory therapy related to mortality in cardiothoracic admissions between October 2007-September 2009

Diagnosis	N (% of total)	Ventilated N (%)	Mortality N (%)
Blunt chest injury	13 (13.5)	4 (30.8)	1 (0.08)
BT shunt for Tetralogy of Fallot	5 (5.2)	4 (80.0)	2 (40)
Post-esophageal stricture/achalasia repair	18 (18.8)	11 (61.1)	1 (0.06)
Post-feeding jejunostomy/venting gastrostomy	2 (2.1)	0	2 (100)
PDA ligation	5 (5.2)	1 (20.0)	-
Tracheo-esophageal fistula repair	3 (3.1)	3 (100.0)	3 (100)
Post-pacemaker insertion	14 (14.6)	0	-
Vascular(trauma/aneurysm) repair	4 (4.2)	0	2 (50)
Post-pericardiectomy	7 (7.3)	3 (42.9)	1 (14.2)
Massive pleural effusion	4 (4.2)	1 (25.0)	-
Post-bronchoscopy for foreign body aspiration	3 (3.1)	0	-
Diaphragmatic hernia/injury	3 (3.1)	1 (33.3)	-
Post-bronchogenic cyst excision	1 (1.0)	0	-
Post-excision of Pleural lesions	3 (3.1)	1 (33.3)	-
Post-excision of Lung parenchyma lesions	3 (3.1)	0	-
Penetrating chest injury	3 (3.1)	1 (33.3)	-
Post-excision of mediastinal mass	2 (2.1)	0	1 (50)
Post-CA oesophagus resection	3 (3.1)	2 (66.7)	2 (66.7)
	96	32 (33.3)	15 (15.6)

Table 3: Logistic regression analysis of variables

Variable	P value
Age	0.064
Sex	0.575
Indication	0.764
Admission type	0.512
Length of stay	0.220
Endotracheal intubation	0.001
Ventilatory therapy	0.597
Tracheostomy	0.467
Inotherapy	0.878
CVP monitoring	0.760
Number of days on ventilator	0.352

study which involved 301 cardiothoracic patients who required admission to a multidisciplinary ICU during a 6-year period showed that mortality was higher in extreme old age and in patients referred with sepsis or ventricular failure.

The employment of central venous monitoring for patients in this review was low. This is not because more patients in this review did not require its use, but mainly due to the inadequate

resources available to the ICU because of poor health care funding, which is a common feature in a low resource economy like Nigeria. Therefore, the device was only available for use in few patients due to the high cost of invasive monitoring, which is the standard practice in modern ICU.^[13]

About 40% of patients in this review had endotracheal or tracheostomy tube in place during admission in the ICU, with 33% of this group of patient requiring ventilatory therapy. About 90% of our patients were post-operative admissions and majority of them came into the ICU with endotracheal tube. Logistic regression of treatments offered in this review incriminated endotracheal intubation as a major predictor of poor outcome. This is probably related to those attendant risks and complications associated with endotracheal intubation like tube blockade and chest infection.

The 15% mortality observed amongst cardio-thoracic patients in this review is much lower than the 33% recorded by Okafor and Ezike^[14] in their two year review of pediatric cardio-thoracic admissions in Enugu, Nigeria. This difference may be because our review involved other age groups with a lower group specific mortality.

Reasons for the mortality rate in our series are probably multifactorial but postoperative ICU admission with endotracheal tube in place clearly came out as a determinant factor of outcome. More deaths were recorded in the neonates and very young, but this was not statistically significant. Neonates and the very young have an accentuated stress response in the peri-operative period,^[15] which is further amplified by manipulation of the endotracheal tube and endotracheal suctioning.^[16] Other authors have reviewed the potential deleterious effects of continued endotracheal intubation in this age group like laryngotracheal trauma, mucus plugging, kinking of the endotracheal tube, accidental extubation, and infection.^[17-19] Some of these factors contributed to the mortality observed in this review. In addition, pulmonary hypertensive crises can be caused by manipulation of the endotracheal tube and by tracheal stimulation with suctioning. Furthermore, positive intrapulmonary pressure can increase pulmonary vascular resistance and may impede pulmonary blood flow.^[20]

It has been reported that patients who got early extubation, had shorter ICU and hospital stay and therefore lower cost of care.^[21] The potential benefits of early extubation include cost saving,^[22] lower nursing dependency, reduced airway and lung trauma,^[23] improved cardiac output and renal perfusion with spontaneous respiration^[24] and reduced stress and discomfort of endotracheal suctioning.^[25] The opponents to early extubation argue that the immediate peri-operative period is the most critical for myocardial ischemia, hemodynamic instability and sympathetic nervous system activation.^[26] The concern about immediate or early extubation is the possibility of re-intubation for respiratory failure in the immediate postoperative period. However, this is not common in well selected patients.

It is well recognised that patients who had major cardiothoracic procedures are high risk patients in the early post-operative period and therefore require constant attention. It is important that such patient should have a 1:1 nursing care. When this is not possible due to staff shortage, complications associated with endotracheal tube or tracheostomy may contribute to mortality. Many studies^[27-30] have shown that ICU nurse staffing can have significant impact on patient's outcomes. Fridkin *et al.*^[27] found that a reduction in the nurse-to-patient ratio from 1:1 to 1:2 in the ICU independently increased the risk of catheter-related blood stream infection. Also, Archibald *et al.*^[28] reported that the nosocomial infection rate in a paediatric cardiac ICU was inversely associated with the nursing hours- to- patient ratio.

CONCLUSION

After elective cardio-thoracic procedures, some patients can initially recover in PACU, where alternative resources and specialized teams are readily available, even in the presence of risk factors for postoperative complications. If they are relatively stable but continued monitoring or specialized care is necessary, admission to a HDU is justified and cost-effective. Elective ICU care should be reserved for selected cases identified at the preoperative visit with appropriate workup and after optimization of their clinical and functional status. This will prevent undue pressure on ICU resources and help the hospital and patient relations to save cost. Our review also showed that endotracheal intubation was the main predictor of a poor outcome irrespective of patient characteristics. In view of this, we opine that the decision to continue with endotracheal intubation in the post-operative patients or employing it in other groups of cardio-thoracic patients in the ICU should be critically evaluated before use. In addition, whenever a patient has a tracheal tube in situ, a 1:1 nurse/patient ratio must be instituted.

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