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Unexpected Deaths Following Surgical Intensive Care Unit Discharge: A Six-Year Controlled Analysis

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Abstract

Aim: To investigate the occurrence and causes of unexpected death on non-ICU floors after surgical ICU discharge.

Methods: A retrospective chart review was conducted at an 1171-bed university hospital. All patients who were discharged alive from 14-bed SICU to non-ICU floors between January 1, 2008 and September 30, 2013 were screened for enrollment. Patients who expired on non-ICU floors (not palliative care unit or hospice) within 28 days after SICU discharge and had no documented Do Not Intubate (DNI)/ Do Not Resuscitate (DNR) orders were defined as unexpected death and included for analysis. The primary outcome was the occurrence, timing, and cause of unexpected death following SICU discharge. Next, a matched control group was selected based on primary diagnosis, age and sex. Daytime ICU discharge (7 am to 7 pm), ICU and hospital length of stay, Acute Physiology and Chronic Health Evaluation (APACHE) II score at SICU admission and SWIFT (Stability and Workload Index for Transfer) score at SICU discharge were compared between the two groups.

Results: Fourteen (0.4%) of the 3,213 discharged alive patients met the criteria of unexpected deaths. The causes of unexpected death were intra-abdominal sepsis (5/14, 36%) followed by Pulmonary Embolism (PE) (4/14, 29%), Myocardial Infarction (MI) (2/14, 14%), progressive Congestive Heart Failure (CHF) (1/14, 7%), aortic dissection (1/14, 7%) and aspiration pneumonia (1/14, 7%). While sepsis was most common (4/5, 80%) in the first seven days after SICU discharge, cardiovascular events such as PE, MI, CHF or aortic dissection were more common (7/9, 78%) thereafter. There was no difference in daytime discharge, hospital and ICU length of stay, APACHE II score or SWIFT score between the two groups.

Conclusion: The occurrence of unexpected death after SICU discharges was 14/3,213 (0.4%). The most common cause was sepsis within first seven days, and cardiovascular events thereafter. No impact of time of the ICU discharge, ICU length of stay, severity of illness or readmission risk scores on predicting ICU readmission or unexpected deaths.

Keywords: Premature ICU discharge; Unexpected death; SICU; Daytime ICU discharge; APACHE II score; SWIFT score

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Abbreviations

ICU: Intensive Care Unit; SICU: Surgical Intensive Care Unit; DNI: Do Not Intubate; DNR: Do Not Resuscitate; APACHE: Acute Physiology and Chronic Health Evaluation; SWIFT: Stability and Workload Index for Transfer; PE: Pulmonary Embolism; MI: Myocardial Infarction; CHF: Congestive Heart Failure; DVT: Deep Vein Thrombosis

Introduction

It is inevitable to have a number of patients who survived to ICU discharge who eventually die unexpectedly during the same hospital admission. While it is devastating to the patients and family, it is also demoralizing to the ICU staff that cared for these critically ill patients. This population is neither well described nor clear if any preventable factors contributed to the mortality particularly in surgical patients. One often raises the question if these patients had remained in the ICU the outcome would have been different.

Previous studies have correlated premature discharge from the ICU with increased in-hospital mortality [1,2]. In a study, 11% of the discharged ICU patients subsequently died. This was increased to 21.4% in patients who had a high Therapeutic Intervention Scoring System (TISS) score [3].

Other studies have demonstrated that after-hours ICU discharges are at increased risk of death [4,5]. In a recent Japanese study, unexpected death after ICU discharge was 9.8% and transfer from non-ICU floor, metastatic cancer, hematologic malignancy, high APACHE II score, requirement of re-intubation and mechanical ventilation upon ICU discharge were considered the independent risk factors [6]. However, none of these studies focused on surgical patients who may decompensate for a variety of reasons different from medical patients. None of the studies had a controlled arm to compare the impact of the severity of illness (as reflected by APACHE II score), ICU length of stay, time of ICU discharge and patient's stability at time of ICU discharge (SWIFT score).

The aim of this study was to describe the occurrence, timing and cause of death in surgical patients who died on non-ICU floors unexpectedly following discharge from the SICU. Also, predicting scoring indices, ICU length of stay and daytime ICU discharge were reviewed to assess its efficacy as good predictors of post-ICU mortality in this population.

Material and Methods

With Institutional Review Board approval, this study was conducted at the Mount Sinai Hospital, an 1171-bed, urban University Hospital. Due to the nature of this retrospective study, the need for informed consent was waived. All patients discharged alive from the 14-bed SICU to non-ICU floors between January 1, 2008 and September 30, 2013, were screened for enrollment. Patients who were directly discharged from SICU to home or skilled nursing facility were not included for analysis. Based on the nature of their death, "unexpected death" group was defined, and it consisted of the patients who expired on non-ICU floors within 28 days following SICU discharge. For the patients who had documented DNI or DNR order, who were discharged to a palliative care unit or hospice, their death was considered expected and they were not included in 'unexpected death' group.

For the 'unexpected death' group, chart review was performed to record basic characteristics, the cause of death, and the interval from SICU discharge to unexpected death on non-ICU floors. Next, a matched control group was selected based on primary diagnosis, age and sex from the patients who were discharged alive from SICU and survived beyond 28 days following SICU discharge. Lengths of stay in SICU, length of stay in hospital, proportion of daytime (7 am to 7 pm) discharge from SICU, Acute Physiology and Chronic Health Evaluation (APACHE) II score on admission to SICU and the Stability and Workload Index for Transfer (SWIFT) score on discharge from SICU were compared between the two groups [7,8]. The data were compared and analyzed using student t-test for quantitative variables and Pearson chi square test for dichotomous variables.

Results and Discussion

There were 3,608 patients admitted to SICU, and 3,213 of them were discharged alive from the SICU to non-ICU floors during the study period. While 2,986 (93%) patients survived to hospital discharge, 227 (7%) patients died in the hospital (Figure 1). Of the 227 patients who died on non-ICU floors, 130 (4%) died within 28 days and 97 (3%) died after 28 days. Among the 130 patients who died within 28 days, 116 (3.6%) patients were considered expected death and excluded from analysis. Finally, 14 (0.4%) patients were categorized as unexpected deaths (Table 1). The leading causes of unexpected death on non-ICU floors were intra-abdominal sepsis

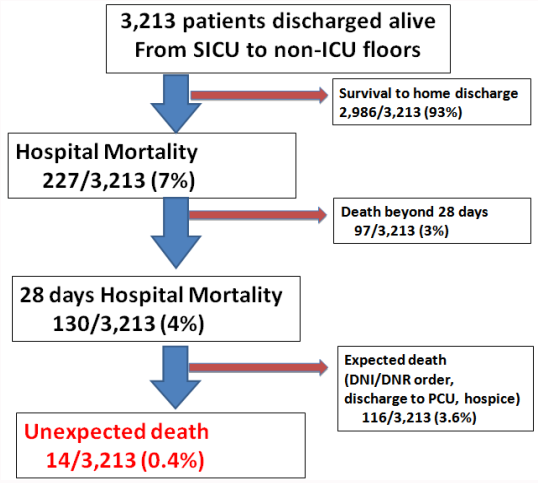

Figure 1: Participant Flow sheet.

(5/14, 29%) followed by pulmonary embolism (4/14, 29%) with two clinically diagnosed cases, myocardial infarction (2/14, 14%), aspiration pneumonia (1/14, 7%), aortic dissection (1/14, 7%) and congestive heart failure (1/14, 7%) (Table 2). When looking at the interval from SICU discharge to unexpected death, sepsis was the most common cause of death within the first seven days (4/5, 80%) including intra-abdominal sepsis (3 cases) and aspiration pneumonia (1 case). On the other hand, cardiovascular events such as PE, MI, CHF and aortic dissection were more common (7/9, 78%) compared to sepsis (2/9, 22%) after seven days. When comparing prognostic indices, there was no difference between the two groups in length of stay in SICU (10.5 ± 10.8 *vs.* 11.3 ± 12.0 days; p=0.86), length of stay in hospital (33.9 ± 26.1 *vs.* 35.0 ± 23.8 days; p=0.89), the percentage of daytime discharge from the SICU [5/14 (36%) *vs.* 6/14 (43%); p=0.70], the APACHE II score at SICU admission (16.4 ± 6.0 *vs.* 16.6 ± 3.1; p=0.89), and SWIFT score at SICU discharge (19.6 ± 7.9 *vs.* 15.8 ± 8.8; p=0.24) (Table 3).

The occurrence of unexpected death on non-ICU floors within 28 days after SICU discharge was 14/3,213 (0.4%) in our study. This occurrence was much lower compared to the previous study (5% to 11%) and several reasons were considered [3,7]. First, while the previous study set no time limitation from ICU discharge to unexpected death on non-ICU floors, our study included only patients who died within 28 days after ICU discharge. However, death within 28 days after ICU discharge was deemed a reasonable outcome for this study in order to clarify the causal relationship between the patient's status at the time of SICU discharge and their unexpected death on non-ICU floors. Second, as the Palliative Care

Table 1: Characteristics for Patients with Unexpected Death.

Characteristics	(n=14)
Age (yrs)	50 - 90 (mean 66)
Female Sex No (%)	5/14(36 %)
Autopsy No (%)	4/14(29 %)
Primary Diagnosis On SICU Admission	
Gastrointestinal Disease	6/14 (43 %)
Cardiothoracic Disease	4/14 (29 %)
Hepatobiliary Disease	3/14 (21 %)
Gynecological Disease	1/14 (1 %)

Table 2: The Causes of Unexpected Death.

	Day 1 to 7	Day 8 to 14	Day 15 to 21	Day 22 to 28	Total No
Intra-abdominal Sepsis	3		1	1	**5**
Pulmonary Embolism	1	1	1	1	**4**
Myocardial Infarction			1	1	**2**
Aspiration Pneumonia	1				**1**
Aortic Dissection		1			**1**
CHF			1		**1**
Total No	**5**	**2**	**4**	**3**	**14**

team is proactively consulted in our facility, potential unexpected death cases can be avoided through definition of long-term care goals and expectations. Third, the surgical critical care consultation service continues to follow patients and contribute to care of patients post SICU discharge for up to 24 h or while patients remain in high dependency unit till further monitoring is no longer needed.

In our study, intra-abdominal sepsis and pulmonary embolism were most common cause of unexpected death within 28 days of SICU discharge. This result differs from the report by Mayr et al. [7] where malignant tumor disease followed by exacerbation of chronic cardiovascular disease and acute cardiovascular disease were the most common causes of death after ICU discharge. This is likely because their patients were included up to one year after ICU discharge, and also they did not define unexpected death. As a result, the results did not appear to reflect the causes of unexpected death related to the patient's status at the time of SICU discharge.

In our study, sepsis especially intra-abdominal sepsis was most common cause of death in the first seven days following SICU discharge. This may represent that patients admitted to the SICU are often in critical condition after abdominal surgery with complications that increase their risk of morbidity and mortality. It is not clear if patients with intra-abdominal sepsis need to be monitored closer following SICU discharge to non-ICU floors. Our patient population often has underlying malignant or chronic diseases that impact daily quality of life. There is often considerable increased risk with any medical or surgical interventions, as well as greater risk for complications in recovery such as Deep Vein Thrombosis (DVT) or PE even when DVT prophylaxis is practiced. In the present study, 3/4 (75%) patients were either receiving unfractionated heparin or low molecular weight heparin subcutaneously per protocol for DVT prophylaxis at the time of death from PE except for one patient with a recent episode of gastrointestinal bleeding.

As it has been previously reported, premature ICU discharge increases the risk of mortality significantly [8]. In the face of limited bed resources, transferring the least severe patients out of the SICU to admit more critically-ill patients is standard of practice. High dependency units became an alternative place to monitor the less acutely-ill patients closely, however, bed capacity and competition with post-operative patients as well as contact isolation status of the patients makes this option not always available. In the present study, only 2/14 patients (14%) were accepted to step down unit. In order to compensate the limited bed resources, several scoring systems have been proposed and studied in the last decade to predict ICU readmission. Although previous studies have demonstrated promising data [9-11], no established scoring system other than subjective clinical judgment and experience exists yet to determine optimal timing of discharge from the ICU [12]. In our study neither

Table 3: Unexpected Death (UD) *vs.* Matched Control (MC).

Characteristics	UD (n=14)	MC (n=14)	P value
Age (yrs)	65.9 ± 12.5	66.0 ± 11.2	p=0.96
Females (%)	5/14 (36%)	5/14 (36%)	p=1
Daytime (7AM to 7PM) discharge (%)	5/14 (36%)	6/14 (43%)	P=0.70
ICU LOS (days)	10.5 ± 10.8	11.3 ± 12.0	p=0.86
Hospital LOS (days)	33.9 ± 26.1	35.0 ± 23.8	p=0.89
APACHE II score on ICU admission	16.4 ± 6.0	16.6 ± 3.1	p=0.89
SWIFT score on ICU discharge	19.6 ± 7.9	15.8 ± 8.8	p=0.24

APACHE II score nor SWIFT score demonstrated a statistical significance to predict ICU readmission. However, cautious interpretation is required for this result because the number of patients analyzed in our study was quite small and this might have hindered its real significance.

The impact of the timing of ICU discharge has been reported but with conflicting results [4,13]. In a review of 22 studies [5], post ICU mortality was associated with older age, acuity of illness and after hours discharge. Our findings do not confirm these factors in surgical patients. Surgical patients, similar to medical patients have common factors contributing to their outcome, including age, severity of illness, ICU LOS, premorbid conditions. Surgical patients, however, have additional determining factors including the surgery by itself, the surgical urgency, bleeding, transfusion requirement, trauma factors. This distinguishes surgical patient's outcome form medical counterparts.

There are possible reasons for the very low rates of unexpected deaths in our study. First, the surgical critical care consult service is actively involved in management and surveillance of patients in surgical step down as well as post SICU discharge. Second, post SICU discharge often go to high dependency unit, surgical patient dedicated high dependency units (total 30 beds) which high nursing to patient's ratio (1:3) on continuous standard monitoring devices. Third, the establishment of palliative care program in the SICU and daily rounding and interventions by the palliative care team together with the critical care team. This process has proven its value in family support and early establishments of goals of care when appropriate.

This study offers a not well studied population with new insight on etiologies of unexpected death. We also demonstrates that current commonly used predictive tool were not sensitive in this population. A better predictive tool is needed that is applicable to surgical population. The study included autopsy finding in 4 of the 14 patients.

There are several limitations in this study. First, this is a retrospective study and a selecting bias may exist during a process

of selecting a matched control group. Second, unexpected death was limited within 28 days post SICU discharge. Third, the number of patients categorized as 'unexpected death' was small, and consequently, the results might have underpowered to prove the significance of daytime ICU discharge, APACHE II score or SWIFT score to predict post-ICU mortality.

Conclusion

The occurrence of unexpected death on non-ICU floors within 28 days after SICU discharge was very rare (14/3,213, 0.4%). Intra-abdominal sepsis was the most common cause of death within the first seven days from SICU discharge, while cardiovascular events were more common after seven days. It is not clear if additional monitoring of this population would have changed the outcome of these patients. The efficacy of SWIFT score or APACHE II score deemed not to be valuable in predicting ICU unexpected deaths in this population.

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