Medicine versus surgery/anesthesiology intensivists: a retrospective review and comparison of outcomes in a mixed medical–surgical–trauma ICU

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Background: With various types of complex patients being treated in a mixed medical–surgical–trauma intensive care unit (ICU), we hypothesized that there should be no difference in patient mortality with respect to the core training of the intensivist.

Methods: We reviewed the cases of all patients admitted to a mixed medical–surgical–trauma ICU at a Canadian university teaching hospital in 2007. Patients were assigned to 1 of 2 treatment groups (internal medicine, surgery/anesthesiology) based on the treating intensivist's training. Our primary outcome was to compare patient mortality in the ICU between the groups. We used generalized estimating equations to determine 10-day mortality after admission to the ICU. A multivariate Cox hazard model was used to determine statistical significance and 95% confidence intervals (CIs) for 11- to 60-day mortality in the ICU.

Results: A total of 961 patients were admitted from January to December, 2007. We found no significant difference between the groups in 10-day mortality (odds ratio 0.73, 95% CI 0.46–1.18, $p = 0.20$) and 11- to 60-day mortality (hazard ratio 1.43, 95% CI 0.62–3.30, $p = 0.40$) after admission to the ICU.

Conclusion: In a large university trauma centre that operates a mixed medicine–surgical–trauma ICU, there was no significant difference in mortality between patients managed by intensivists with core training in internal medicine and those managed by intensivists with training in surgery/anesthesiology.

Contexte : Compte tenu de la variété de cas complexes traités dans les unités de soins intensifs (USI) mixtes de médecine–chirurgie–traumatologie, nous avons émis l'hypothèse selon laquelle il ne devrait y avoir aucune différence en ce qui concerne la mortalité chez les patients selon la formation de base de l'intensiviste.

Méthodes : Nous avons passé en revue les dossiers de tous les patients admis dans l'USI mixte de médecine–chirurgie–traumatologie d'un centre hospitalier universitaire canadien en 2007. Les patients ont été assignés à l'un de 2 groupes (médecine interne ou chirurgie/anesthésie) selon la formation de l'intensiviste traitant. Notre paramètre principal visait à comparer la mortalité des patients des USI selon leur groupe. Nous avons utilisé des équations d'estimation généralisées pour déterminer la mortalité à 10 jours suivant l'admission à l'USI. Et nous avons utilisé un modèle de risque multivarié de Cox pour déterminer la portée statistique et les intervalles de confiance (IC) de 95 % en ce qui concerne la mortalité dans les 11 à 60 jours d'hospitalisation à l'USI.

Résultats : En tout, 961 patients ont été admis entre janvier et décembre 2007. Nous n'avons observé aucune différence significative entre les 2 groupes pour ce qui est de la mortalité à 10 jours (rapport des cotes 0,73, IC de 95 % 0,46–1,18, $p = 0{,}20$) et de la mortalité dans les 11 à 60 jours (rapport des risques 1,43, IC de 95 % 0,62–3,30, $p = 0{,}40$) suivant l'admission à l'USI.

Conclusion : Dans un important centre universitaire de traumatologie doté d'une USI mixte médecine–chirurgie–traumatologie, on n'a noté aucune différence significative quant à la mortalité entre les patients soignés par des intensivistes ayant une formation de base en médecine interne et les patients soignés par des intensivistes ayant une formation de base en chirurgie/anesthésie.

The organization of critical care delivery varies substantially among hospitals and sometimes within the same hospital. Different organizational models include closed, high-intensity staffing units and open units. Critical care is also delivered in mixed units admitting critically ill patients from different specialties and in specialized units admitting only similar types of patients. These latter specialized units can vary in their level of specialization from general (e.g., medical v. surgical) to more specialty-specific (e.g. trauma, cardiac surgery, neurocritical care).

Closed, high-intensity staffing unit models have been recommended by various critical care societies and health agencies, as they have been associated with decreased length of stay in the intensive care unit (ICU), resource utilization, complications and mortality.[1–5] Previous studies have assessed the effects of specialized units on mortality,[6–8] but we could not find any literature examining the effects of core training of intensivists on mortality within a closed unit.

In tertiary-level ICUs, it is common to have intensivists with core training in internal medicine, surgery or anesthesiology. We hypothesized that there should be no difference in mortality with respect to the core training of the treating intensivist in a mixed ICU. To verify this hypothesis, we collected data from 1 university teaching hospital in Montréal, Que.

Methods

ICU description

The Montreal General Hospital (MGH) ICU operates as a closed unit. Contrary to the open model, in which patients are admitted by their primary physician, the closed model enforces stricter administrative and triage controls, and patient care is fully transferred to the intensivist. Patients are admitted to the unit only once the ICU team has evaluated them. The MGH ICU is a mixed medical–surgical–trauma ICU. The mean number of admissions over the last 5 years (2004–2009) has been 1342.2.

The ICU is divided into 2 sides, each with 11 beds. Patients admitted to the ICU are evenly distributed between the sides to have an approximately even number of patients on each side. The admitting diagnosis is not a factor in designation to a certain side. The ICU is staffed by intensivists (i.e., physicians having completed a critical care fellowship, with core training backgrounds in surgery, anesthesiology or internal medicine). One ICU staff member is assigned to manage 1 side of the unit each week; therefore, 2 intensivists staff the ICU in any given week. The ICU staff is distributed to evenly cover both sides over the year. Each side also has a team that comprises several medical students, residents and fellows completing their ICU rotations. Each 1-week shift begins on Monday at 8:00 a.m. and ends the same time the following Monday.

Data collection

We conducted a retrospective review of all patients admitted to the MGH ICU during a 1-year period (Jan. 1 to Dec. 31, 2007). We collected data regarding the patient's age, sex, admitting diagnosis, date and time of admission/discharge to and from the ICU, death during ICU admission, surgical intervention during ICU admission, APACHE II score and Injury Severity Score (ISS) from the MGH electronic ICU and trauma databases. We subsequently created a database compiling this data. We calculated length of stay (LOS) in the ICU from our electronic database. Our study did not require ethical approval or additional consent from patients.

For our analysis, patients were placed in 1 of 2 groups based on the core training of the intensivist treating the patient for the majority (> 50%) of the patients' first 72 hours in the ICU. We believe that the first 72 hours of ICU admission are the most critical, as this is the period in which the patient will be the most unstable and in which most of the investigations and resuscitative interventions will occur. The IM-LOS group included patients treated by intensivists with core training in internal medicine, and the SA-LOS group included patients treated by intensivists with core training in surgery or anesthesiology for the majority of their first 72 hours in the ICU. Anesthesiology was grouped with surgery because, during their training, intensivists with those backgrounds are exposed to similar surgical diseases and trauma patients. In addition, surgeons and anesthesiologists undergo training with an emphasis on acute management and resuscitation. Our main objective was to measure mortality in the ICU. We hypothesized that there would be no difference in mortality between the IM-LOS and SA-LOS groups.

Statistical analysis

Statistical analysis was performed using the SAS System, version 9.2 (SAS Institute). We summarized patient characteristics at baseline using proportions, means or medians, ranges and standard deviations (SD), as appropriate. We performed Student *t* tests or Wilcoxon rank-sum and Kruskal–Wallis tests to compare clinical variables between patients who survived and those who died within the IM-LOS and SA-LOS groups, for normally and non-normally distributed data, respectively. Generalized estimating equations (GEE) for binary data were used to assess the association between 10-day mortality in the ICU and patient group. The assumptions of Cox hazard modelling were met once the data were divided at 10 days of ICU stay. Consequently, we applied a multivariate Cox hazard regression model to assess the association between 11- to 60-day mortality in the ICU and patient group. Variables that were significant ($p < 0.05$) after univariate analysis were entered into the regression model. For this analysis, the Hazard ratio (HR) and 95% confidence interval (CI) for each significant variable are reported. Univariate analyses were carried out for the following variables: patient age, APACHE II score, ISS, patient sex, surgical procedure during admission and LOS.

RESULTS

During our 1-year study period, there were 52 week-long shifts per unit for a total of 104 shifts. There were 59 (56.7%) shifts staffed by intensivists with a background in internal medicine and 45 (43.3) shifts staffed by intensivists with a background in surgery/anesthesiology.

There were 1386 admissions to the ICU in 2007 (578 medical, 413 surgical and 395 trauma). Data, specifically APACHE II scores, were missing for 425 admissions. Therefore, 961 admissions to ICU, including 79 repeat admissions among 882 patients) were eligible for our review. Patient demographic and clinical characteristics are shown in Table 1. Of the 961 admissions, there were 131 deaths, for an overall crude mortality of 14.9%. When patients were classified by group, 555 (57.7%) patients were in the IM-LOS group and 406 (42.3%) in the SA-LOS group (Fig. 1). There were proportionately more medical patients than surgical or trauma patients in both the IM-LOS and the SA-LOS group. The groups were comparable in terms of patient demographic and clinical characteristics (Table 1). The mean APACHE II score was 23.4 and the mean ISS was 26 (Table 1).

Crude mortality for the IM-LOS and SA-LOS groups was 12.6% and 15.0%, respectively. Univariate analysis comparing mortality between the groups showed no statistical difference ($p = 0.28$; Table 1). Table 2 compares the characteristics of patients who survived with those of patients who died; we entered the variables that were significant on univariate analysis into a regression model and multivariate analysis using GEE for 10-day mortality and the Cox Hazard model for 11- to 60-day mortality. We found no difference between the groups in 10-day mortality (odds ratio 0.73, 95% CI 0.46–1.18, $p = 0.20$; Table 3) or 11- to 60-day mortality (hazard ratio 1.43, 95% CI 0.62–3.30, $p = 0.40$; Table 4).

Patient age, APACHE II score and patient type were significant predictors of mortality on univariate analysis (all $p < 0.005$; Table 2). The patients who died in the ICU were slightly older than those who survived (median age 72 [range 15–92] years v. 61 [16–95] yr, $p < 0.001$). The APACHE II scores of patients who died were on average greater than the scores of those who survived (mean 31.0 [range 12–53] v. 22.0 [2–49], $p < 0.001$). Length of stay in the ICU was longer for those who died than for those who

Table 1. Demographic and clinical characteristics of patients treated in the intensive care unit, by group

Characteristic	Group; median (range) or % Total, *n* = 961	IM-LOS, *n* = 555	SA-LOS, *n* = 406	*p* value
Age, yr	59 (15–95)	63 (16–95)	63 (15–92)	0.88
APACHE II score	23.3 (2–53)	23.5 (2–52)	23 (3–53)	0.68
Male sex	65.5	64.1	67.2	0.32
Type of patient (internal medicine)	44.8	48.0	40.4	0.003
Surgical procedure during ICU stay	33.6	32.0	36.0	0.19
ICU LOS, d	2.8 (0.06–59)	2.6 (0.06–59)	3.0 (0.06–48.8)	0.18
Death	13.6	12.6	15.0	0.28

ICU = intensive care unit; IM = internal medicine; LOS = length of stay; SA = surgery or anesthesiology.

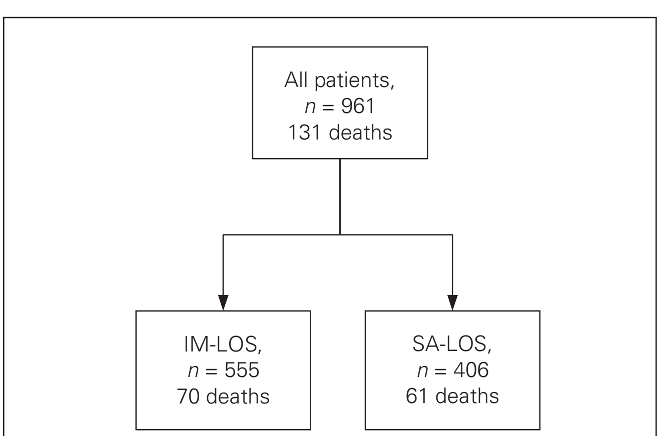

Fig. 1. Patient allocation to treating group. IM-LOS = internal medicine intensivist treating the patient for > 50% of first 72 hours in the intensive care unit (ICU); SA-LOS = surgery/anesthesiology intensivist treating the patient for > 50% of first 72 hours in the ICU.

Table 2. Patient mortality in the intensive care unit

Characteristic	Group; median (range) or % Total, *n* = 961	Survived, *n* = 830	Died, *n* = 131	*p* value
Age, yr	59 (15–95)	61 (16–95)	72 (15–92)	< 0.001
APACHE II score	23.3 (2–53)	22.0 (2–49)	31.0 (12–53)	< 0.001
Male sex	65.5	65.7	64.1	0.73
Type of patient (internal medicine)	44.8	41.6	64.9	< 0.001
Surgical procedure during ICU stay	33.6	35.8	19.8	< 0.001
Group IM-LOS	555	485	70	0.28
Group SA-LOS	406	345	61	
ICU LOS, d	2.8 (0.06–59)	2.6 (0.07–53.8)	4.6 (0.06–59)	0.026

ICU = intensive care unit; IM = internal medicine; LOS = length of stay; SA = surgery or anesthesiology.

Table 3. Generalized estimating equations analysis for repeated-measures of 107 deaths in 799 patients within 10 days of admission to the intensive care unit

Characteristic	Hazard ratio (95% CI)	*p* value
Age	1.02 (1.01–1.04)	0.007
APACHE II score	1.18 (1.14–1.23)	< 0.001
Type of patient*	0.81 (0.42–1.55)	0.52
Group IM-LOS v. SA-LOS	0.73 (0.46–1.18)	0.20
Surgical procedure	0.96 (0.48–1.91)	0.90

CI = confidence interval; IM = internal medicine; LOS = length of stay; SA = surgery or anesthesiology.
*Medical versus surgical versus trauma based on admitting diagnosis.

survived (mean 4.6 [range 0.06–59] d v. 2.6 [0.07–53.8] d). APACHE II scores were a significant factor throughout our analyses.

Discussion

To our knowledge, our study is the first attempt at comparing patient mortality based on the background training of attending intensivists. With a large variety of critically ill patients being admitted to our mixed medical–surgical–trauma ICU, our results demonstrate that there is no significant difference in mortality with respect to the core training of the intensivist. We consistently found that APACHE II score was associated with mortality, indicating that it is an accurate predictor of mortality.

Lott and colleagues[6] suggested that there are no survival benefits to specialty ICU care over general ICU care. They stated that critically ill patients face similar critical illness syndromes, such as acute respiratory failure, lung injury and sepsis, regardless of the admitting diagnosis, obviating the need for specialized care.[6] One of the limitations of their study was their inability to adjust for ICU organizational factors, including intensivist staffing and training. Our study shows that within a closed ICU setting staffed by critical care–certified intensivists, the core training of the intensivist has no significant effect on mortality.

It has also been described that specialty ICUs may promote "burnout syndrome," which has been described as a psychological disorder experienced by ICU staff owing to prolonged exposure to work-related stressors.[9] The narrow spectrum of diagnosis and tasks associated with specialty ICUs may increase the risk for burnout syndrome, which may result in inferior performance and, thus inferior patient outcomes. Furthermore, it has been suggested that implementing specialty ICUs may be more costly and require more specialized staff.[10] Our results suggest that perhaps the investment in specialty ICU facilities is not warranted in terms of improving patient survival in the ICU.

Opposing conclusions have also been stated in the literature. Mirski and colleagues[7] and Diringer and Edwards[8] reported improvements in patient outcomes, although their findings pertained to patients with intracerebral hemorrhages treated within a neuroscience unit. Similarly, Duane and colleagues[11] support the concept of specialized ICU care; they suggested that trauma patients should be appropriately managed in a trauma ICU, as severely injured trauma patients require the extensive experience that only a surgery/trauma ICU can provide; however, the authors concluded that this was less of a factor in less severely injured patients. In our subgroup analysis, we found no difference in mortality between trauma patients in the SA-LOS group and those in the IM-LOS group.

Table 4. Cox hazard model analysis of 24 deaths in 162 patients between day 11 and day 60 in the intensive care unit

Characteristic	Hazard ratio (95% CI)	*p* value
Age	1.03 (1.0–1.06)	0.07
APACHE II score	1.01 (0.95–1.07)	0.82
Type of patient*	1.84 (0.55–6.14)	0.32
Group IM-LOS v. SA-LOS	1.43 (0.62–3.30)	0.40
Surgical procedure	0.80 (0.17–3.84)	0.78

CI = confidence interval; IM = internal medicine; LOS = length of stay; SA = surgery or anesthesiology.
*Medical versus surgical versus trauma based on admitting diagnosis.

Limitations

In our analysis, anesthesiology was grouped with surgery as, during their training, intensivists with either of these training backgrounds are similarly exposed to surgical diseases with an emphasis on resuscitation. Although we believe that the core training in anesthesiology and surgery are similar, differences do exist and may have influenced our results. Anesthesiology was not analyzed as its own group owing to the small number of intensivists with residency training in anesthesiology. Furthermore, although all intensivists at the MGH have completed a critical care fellowship, differences exist among the fellowship programs. Variability existed among the intensivists with core training in surgery/anesthesiology, with one-third having trauma and critical care medicine fellowships, one-third having surgical critical care fellowships and one-third having critical care fellowships. When looking at the intensivists with core training in internal medicine, 60% had completed critical care fellowships, whereas 40% had completed pulmonary and critical care fellowships. Finally, when comparing years of training between the intensivists with training in internal medicine and those with training in surgery or anesthesiology, we found no statistical difference in years of training (median 14 [range 1–17] yr v. 8.5 [range 2–26] yr, $p > 0.99$).

The overall crude mortality of 14.9% for our mixed medical–surgical–trauma ICU falls within the range of 6%–16% reported in the literature.[12–14]

Conclusion

In a large university trauma centre that operates a mixed medicine–surgical–trauma ICU, we found no significant difference in mortality among complex, critically ill patients managed by intensivists with core training backgrounds in either internal medicine or in surgery/anesthesiology. Our results revealed the APACHE II score to be a significant predictor of 10-day mortality in the ICU.

Competing interests: None declared.

Contributors: J. Lee, S. Iqbal and K. Khwaja designed the study. J. Lee and A. Gursahaney acquired the data. J. Lee and N. Thamer wrote the article, which S. Iqbal, A. Gursahaney, N. Thamer and K. Khwaja reviewed. All authors analyzed the data and approved publication.

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