Length of stay, wait time to surgery and 30-day mortality for patients with hip fractures after the opening of a dedicated orthopedic weekend trauma room

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Background: In September 2011, Kingston General Hospital (KGH) opened a dedicated orthopedic weekend trauma room. Previously, 1 weekend operating room (OR) was used by all surgical services. We assessed the impact this dedicated weekend trauma room had on hospital length of stay (LOS), time to surgery and 30-day mortality for patients with hip fractures.

Methods: Patients admitted between Oct. 1, 2009, and Sept. 30, 2012, were identified through our trauma registry, representing the 2 years before and 1 year after the opening of the orthopedic weekend trauma room. We documented type of fracture, mode of fixation, age, sex, American Society of Anesthesiologists (ASA) score, time to OR, LOS, discharge disposition and 30-day mortality. We excluded patients with multiple fractures, open fractures and those requiring trauma team activation.

Results: Our study included 609 patients (405 pre- and 204 post–trauma room opening). Mean LOS decreased from 11.6 to 9.4 days (p = 0.005) and there was a decreasing trend in mean time to OR from 31.5 to 28.5 hours (p = 0.16). There was no difference in 30-day mortality (p = 0.24). The LOS decreased by an average of 2 days following opening of the weekend trauma room (p = 0.031) and by an average of 2.2 additional days if the patient was admitted on the weekend versus during the week (p = 0.024).

Conclusion: The weekend trauma OR at KGH significantly decreased the LOS and appears to have decreased wait times to surgery. Further analysis is needed to assess the cost-effectiveness of the current strategy, the long-term outcome of this patient population and the impact the additional orthopedic weekend trauma room has had on other surgical services (i.e., general surgery) and their patients.

Contexte : En septembre 2011, l'Hôpital général de Kingston (HGK) a rendu disponible la fin de semaine une salle d'opération consacrée exclusivement aux traumas orthopédiques. Auparavant, une seule salle d'opération était ouverte la fin de semaine, et tous les services de chirurgie se la partageaient. Nous avons évalué l'incidence de la disponibilité de cette nouvelle salle sur la durée de séjour, la durée de l'intervention et le taux de mortalité dans les 30 premiers jours des patients ayant une fracture de la hanche.

Méthodes : Nous avons recensé dans nos registres de traumatismes les patients hospitalisés entre le 1er octobre 2009 et le 30 septembre 2012, ce qui correspond à 2 années avant et 1 année après l'ouverture de la salle de fin de semaine. Nous avons noté le type de fracture, le mode de fixation, l'âge, le sexe, le score ASA (de l'American Society of Anesthesiologists), le délai avant l'entrée en salle d'opération, la durée de séjour, l'état à la sortie et le taux de mortalité dans les 30 premiers jours. Nous avons exclu les patients ayant subi de multiples fractures ou des fractures ouvertes et ceux ayant nécessité l'activation de l'équipe de trauma.

Résultats : L'étude portait sur 609 patients (405 avant et 204 après l'ouverture de la salle). La durée de séjour moyenne a diminué après l'ouverture, passant de 11,6 à 9,4 jours (p = 0,005), tout comme le délai moyen avant l'entrée en salle d'opération, qui est passé de 31,5 à 28,5 heures (p = 0,16). Aucune différence n'a été relevée pour ce qui est du taux de mortalité dans les 30 premiers jours (p = 0,24). La diminution moyenne de la durée de séjour après l'ouverture de la salle était de 2 jours (p = 0,031), et de 2,2 jours additionnels si le patient avait été hospitalisé durant la fin de semaine (p = 0,024).

Conclusion : L'ouverture durant la fin de semaine d'une salle d'opération réservée aux traumas à l'HGK a entraîné une baisse significative de la durée de séjour, et semble avoir entraîné une diminution du temps d'attente avant l'intervention. D'autres recherches seront nécessaires pour évaluer l'efficacité de la stratégie actuelle en fonction du coût, les résultats à long terme chez cette population de patients et l'incidence de l'ajout de cette salle sur les autres services de chirurgie (chirurgie générale) et leurs patients.

Hip fractures are a relatively common occurrence in the elderly population and pose a substantial financial burden on the health care system.[1] Low-energy mechanical falls are the most common mechanism, and osteoporosis is the underlying cause in the vast majority of cases.[2] The incidence of hip fractures increases exponentially after the age of 50 years,[3] approximately doubling every 5 years thereafter.[4] In Ontario, the hip fracture rate is approximately 3.3 per 1000 persons (1.7 men v. 4.6 women),[4] which is comparable to other locations around the world.[5–7] One-year mortality has been estimated to be 12%–37%,[8,9] and 4%–12% of patients will die during their initial admission.[8,10,11] Approximately 11% of patients who survive to be discharged home or transferred to another facility will be readmitted within 2 years secondary to another fracture, and 5.6% of patients will experience a second hip fracture in their lifetime.[12] The mean length of stay (LOS) in hospital following a hip fracture is approximately 21 days.[4,12,13] Wiktorowicz and colleagues[12] examined the health care burden of hip fractures in Canada and found that the yearly cost was approximately $26 000 per patient and that the initial hospitalization of community-dwelling patients accounted for 58% of this cost. The annual economic impact of hip fractures in Canada at the turn of the century was approximately $650 million, and this is projected to increase to approximately $2 billion by the year 2041.[12] With the aging patient population and with limited and diminishing resources, it will be up to hospitals to find more efficient ways of providing high-quality health care to patients with hip fractures.

In September 2011, Kingston General Hospital (KGH), a tertiary care centre affiliated with Queen's University with approximately 200 inpatient surgical beds, opened a dedicated orthopedic surgical trauma room on Saturdays and Sundays. Prior to the addition of the weekend trauma time, hip fractures were already given a higher priority than other orthopedic surgical conditions, with a target time to surgery within 48 hours of admission. However, on weekends only 1 operating room (OR) was used by all surgical services. The aim of this study was to assess the impact the dedicated weekend orthopedic surgical trauma room had on LOS, wait time to surgery and 30-day mortality for patients admitted with hip fractures.

Methods

Ethics approval was obtained following Research Ethics Board review. All patients admitted to KGH with a diagnosis of hip fracture between Oct. 1, 2009, and Sept. 30, 2012, were identified through our trauma registry, representing the 2 years before and 1 year after the opening of the weekend orthopedic trauma room. Nine staff surgeons performed surgical fixation depending on the trauma call schedule.

We reviewed patient charts and collected data, including type of fracture, mode of fixation, age, sex, American Society of Anesthesiologists (ASA) score, time from admission to fixation, LOS, discharge disposition and 30-day mortality. Thirty-day mortality was determined through follow-up records and by contacting family physicians, patients, families and permanent residences. All the patients included in the study were accounted for.

We included patients with a diagnosis of subcapital fracture, femoral neck fracture, basicervical fracture, intertrochanteric fracture or subtrochanteric extension fracture. We excluded patients for whom no diagnosis was available, those who died before surgical fixation, those who underwent nonoperative management, those who had open fractures or additional fractures/injuries and those who required trauma team activation.

Statistical analysis

Data were entered into an Excel spreadsheet and imported into SPSS version 22.0 for Windows (IBM) for statistical analysis. Data were initially analyzed descriptively, including frequencies and percentages for categorical data and means and standard deviations for continuous data. We graphed LOS and time to OR to assess their underlying distribution. We compared the pre- and post–trauma room groups using χ^2 tests for categorical data, independent samples t tests for continuous data and the Mann–Whitney U test for LOS. Additional analyses included Pearson and Spearman correlations to assess the associations between continuous variables, such as age, with ASA, LOS and time to OR. Variables with a potential association (e.g., $p < 0.15$) with the outcomes on the bivariate analyses were entered into multivariable linear regression models to identify predictors of LOS and time to OR. For LOS, outliers (defined as the mean ± 3 standard deviations) were removed to normalize the data. This

was considered preferable to log-transformation as the original unit of measure (days) is retained and it was the intent to assess the associations for typical patients rather than the very few outliers who were awaiting placement for long-term care.

Results

We included 609 patients in the analysis: 423 women (69.5%) and 186 men (30.5%). The mean age at diagnosis was 79.5 ± 12.6 (range 17–105) years, the mean time from admission to operative fixation was 30 ± 24.1 h, and the mean operative duration was 61 ± 22.6 min. The median LOS was 7.7 days, with the 25th and 75th percentiles being 5.0 and 12.7 days, respectively. The most frequent admitting diagnoses were intertrochanteric fracture (40.8%) and femoral neck fracture (36.9%). More than half (58.8%) of patients had an ASA classification of 3, and 24.6% had an ASA classification of 4. Thirty-two patients (5.3%) died within 30 days of their admission, 272 (44.7%) were discharged to long-term care facilities, and 237 patients (38.8%) were discharged to their homes with support services. The most frequent modes of surgical fixation were bipolar hemiarthroplasties (28.8%), cephalomedullary nails (28%) and dynamic hip screw constructs (23.8%). Twelve patients were considered LOS outliers and were removed to normalize the distribution, although they were retained in all other analyses. Of these, 10 of 405 (2.5%) were from the pre–trauma room group and 2 of 204 were from the post–trauma room group ($p = 0.35$).

We performed Student *t* tests on the continuous outcome data (LOS, duration of surgery, time to OR) and found no association between these data and sex or operative side, but the patients admitted over the weekend (Friday to Sunday) were found to have shorter LOS than patients admitted during the week ($p = 0.017$). Time to OR was longer for admissions occurring between Friday and Sunday ($p = 0.036$).

The pre and post–trauma room periods are compared in Table 1. Correlation between continuous data points were analyzed using the Pearson correlation test. Older patients had higher ASA classification scores ($p < 0.001$), shorter duration of surgery ($p = 0.003$), and longer time to OR ($p < 0.001$); using the Spearman rho correlation test, older patients had longer LOS ($p < 0.002$).

Multivariable linear regression (Table 2) was performed after controlling for age, ASA class and weekend (Friday–Sunday) versus weekday (Monday–Thursday) admission. The LOS was decreased by an average of 2 days following opening of the weekend trauma room ($p = 0.031$) and by an average of 2.2 additional days if the patient was admitted on the weekend versus during the week ($p = 0.024$). In addition, each 1-point increase in ASA level was associated with an average of 2.9 additional days ($p < 0.001$), while age was not significant ($p = 0.64$). The multivariable model for time to OR indicated an average decrease of 2.4 h following the implementation of the weekend trauma room, although the results fell short of statistical significance ($p = 0.25$) with other stronger variables in the model. Of note, every 1-point increase in ASA class resulted in an average of 10.7 additional hours of surgical delay ($p < 0.001$).

Table 1. Comparison of key factors pre– and post–trauma room opening

Characteristic	Time period; no. or mean ± SD: Pre–trauma room *n* = 405	Post–trauma room *n* = 204	*p* value
Male sex	122	64	0.75
Weekend surgery (Fri–Sun)	185	87	0.48
Death	17	13	0.24
Age, yr	80.0 ± 12.1	78.2 ± 13.8	0.10
ASA class	3.2 ± 0.7	3.1 ± 0.6	0.10
Overall			
Time to operative fixation, h	31.5 ± 27.0	28.5 ± 16.8	0.16
Duration of surgery, min	60.7 ± 22.6	61.6 ± 22.6	0.67
LOS, d*	11.6 ± 11.5	9.4 ± 7.3	0.005
Subset with weekday surgery			
Time to operative fixation, h	29.3 ± 25.2	29.6 ± 17.7	0.93
Duration of surgery, min	60.8 ± 23.3	59.8 ± 21.9	0.74
LOS, d*	11.3 ± 11.0	9.6 ± 7.2	0.14
Subset with weekend surgery			
Time to operative fixation, h	34.0 ± 28.8	27.1 ± 15.4	0.011
Duration of surgery, min	60.7 ± 21.8	63.9 ± 23.3	0.28
LOS, d*	11.9 ± 12.1	9.1 ± 7.5	0.021

ASA = American Society of Anesthesiologists; LOS = length of stay in hospital; SD = standard deviation.
*After removal of 12 outliers.

Table 2. Multivariable linear regression models for time to operative fixation and length of stay

Variable	Coefficient (95% CI)	*p* value
Operative fixation		
Constant	12.6 (–1.0 to 26.3)	0.07
Timing, weekend trauma room	–2.4 (–6.5 to 1.7)	0.25
Age, yr	–0.19 (–0.35 to –0.04)	0.016
ASA class	10.7 (7.7 to 13.8)	< 0.001
LOS		
Constant	4.2 (–2.3 – 10.8)	0.21
Timing, weekend trauma room	–2.0 (–3.8 to –0.2)	0.030
Age, yr	0.02 (–0.05 to 0.9)	0.64
ASA class	2.9 (1.5 to 4.2)	< 0.001
Weekday v. Weekend	–2.1 (–4.0 to –0.3)	0.024

ASA = American Society of Anesthesiologists; CI = confidence interval; LOS = length of stay in hospital.

Discussion

It may be intuitively obvious that adding extra dedicated orthopedic trauma room time on the weekend would

decrease time to surgery and LOS. However, in a climate of resource constraints it is important to evaluate the effectiveness of policy decisions objectively. We chose to evaluate a fracture type that was already given priority over less urgent cases to better gauge whether this policy change would have a substantial impact. One could argue that routine outpatient fracture fixation (e.g., wrist fractures) performed 2 days earlier may not have major long-term outcome benefits. By contrast, hip fractures are associated with lengthy hospital stays, they have a substantial impact on the functional status of patients and they carry high mortality. It should be noted that there was already a policy in place to complete hip fracture surgery within 24–48 h once the patient was deemed medically stable. The completion of these cases competes with other urgent cases, both orthopedic and nonorthopedic. There were no identified additional policy changes or formal initiatives undertaken during the study period that would confound the results.

Our results are of interest for several reasons. After controlling for appropriate variables, LOS was decreased by 2 days overall and by an additional 2 days for patients admitted on the weekend. The daily cost of keeping a senior patient in hospital is approximately $900 per day (excluding investigations),[14] and although a complete cost analysis was beyond the scope of this study, a decrease of 2–4 days is economically substantial. Moreover, time to OR decreased by 2.4 h overall, and while not significant in the multivariable model, this decrease was significant in univariate analysis when looking at the subset of patients who underwent weekend surgery, where there was an average decrease of 6.9 h. The 30-day mortality in our study (5.3%) was similar to or better than previously reported North American and European rates.[15–17] Our mortality rate was not adversely affected by the opening of the dedicated weekend orthopedic trauma room, which suggests that patients were not harmed by earlier discharges. Efforts to improve outcomes, including mortality, continue, and the province of Ontario has recently set a benchmark for hip fracture surgery within 48 h of admission.[18]

The mean time from admission to OR was 30 h, which is comparable to other published times[18,19] and under the current guidelines.[19,20] Twenty-five percent of our patients were in the OR within 16 h, and 75% within 40 h. Like at most centres, time to OR is often delayed for patients requiring preoperative optimization (dialysis, echocardiograms, stabilization in the intensive care unit [ICU]).[18] The LOS in the present study is below published standards,[4,12,13] and 75% of our patients are going home, to rehabilitation or to extended care facilities within 13 days. It should be noted that LOS data were badly skewed, and outliers needed to be excluded in order to provide representative data and analysis. This underlines the complex issue of postoperative patient disposition and the continued lack of long-term extended care beds. Given an aging population and diminishing resources, this is an area of care that all hospitals will need to pursue aggressively.

The additional resources allocated to increasing dedicated orthopedic daytime trauma room time from 5 to 7 days per week would seem to be justified based on these results. The benefits extend beyond just patients admitted on the weekend (Friday–Sunday). The timely completion of urgent orthopedic cases on the weekend helped to avoid the typical backlog of cases encountered at the beginning of the week, thus indirectly benefitting patients admitted on weekdays as well.

Conclusion

Hip fractures are and will continue to be a major focus in orthopedic surgery. They are associated with high mortality and decreased independence and are among the most expensive fractures to treat when patient, hospital and societal costs are taken into account. At KGH, the addition of a dedicated orthopedic weekend trauma room has had a positive impact on LOS and time to surgery without negatively affecting mortality. These types of time and resource allocation strategies are and will continue to be important parts of health care delivery in Canada. It is hoped that this study may support the increased availability of dedicated orthopedic trauma time at other centres.

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Competing interests: None declared.

Contributors: M. Taylor and J. Yach designed the study and acquired and analyzed the data, which W. Hopman also analyzed. M. Taylor and J. Yach wrote the article which all authors reviewed and approved for publication.

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