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The Effect of Indirect Admission via Hospital Transfer on Hip Fracture Patients in Ireland

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Introduction

Hip fracture is the most common trauma presentation requiring surgery in Ireland [1]. Hip fracture patients have complex medical, surgical and rehabilitation needs. Less than half of patients regain their pre-admission level of mobility, less than 30% of patients are discharged home and over 20% are transferred to a nursing home [1]. The mean length of stay for all hip fracture admissions in Ireland is 19-21 days [2,1]. Timely rehabilitation is essential in restoring independence and giving the patient the best opportunity to returning home where possible. Hip fracture patients are almost invariably admitted for surgery, and their care is now recognised as a central challenge originating from the global osteoporotic epidemic [3].

As per the British Orthopaedic Association and the British Geriatric Society's Blue Book Standards (see Table 1), all medically fit patients with a hip fracture should have surgery within 48 hours of admission. Delayed surgery beyond that of 48 hours has been shown to result in rising morbidity, most notably an increased risk of perioperative complications, pressure sores, mortality rates and a prolonged length of stay [4,5]. Every 8 hours of delay has been shown to result in an increase in hospital stay of 1 day [6,7].

There are 16 trauma and orthopaedic surgery units in Ireland that manage adult musculoskeletal injuries, including that of hip fractures. There are 10 emergency departments (ED) throughout the country that triage, assess and resuscitate hip fracture patients without having a trauma and orthopaedic surgery unit onsite (see Figure 1). A hospital transfer must be arranged between such ED's and their local trauma and orthopaedic surgical team when hip fractures patients present after a fall. Idle periods and duplications of preoperative assessments on two sites can lead to critical delays in the delivery a time-critical intervention. Such patients can easily fall beyond the 48-hour time-to-surgery cut off. Admission of a patient to a hospital with a catchment area that does not include the patient's address can lead to repatriation delays, and a prolonged time in hospital prior to discharge.

Paucity exists within the Irish literature with regards to the effect that hospital admission route has on a patient's outcome. It is hypothesised that those patients with hip fractures in Ireland admitted via inter-hospital transfer experience a longer time to surgery, prolonged lengths of stay and higher rates of pressure ulcers when compared to those directly admitted and managed in one hospital. The aim of this study is to show the benefit that a national protocol for hip fractures would have in Ireland, which would make use of the newly established hospital networks to introduce ambulance bypass and repatriation links.

Fig. 1 Shown are the 16 trauma and orthopaedic surgery units within Ireland (which are labelled on the left, marked on the map as circles), with the accompanying 10 ED's without such a unit on site (triangles)

Methods

A retrospective cohort study was designed and performed using the Irish Hip Fracture Database (IHFD), a clinically led, web-based prospective audit of hip fracture case mix, care and outcomes. It is a collaborative venture, supported by the Irish Gerontological Society (IGS) and by the Irish Institute of Trauma and Orthopaedic Surgery (IITOS). The National Office of Clinical Audit (NOCA) provides operational governance for the IHFD. Data is collected by individual data collectors in all contributing hospitals, through the Hospital In-Patient Enquiry (HIPE) portal in collaboration with the Healthcare Pricing Office (HPO) [2]. HIPE is a discharge based data collection system.

Patients were separated into two groups based on their “Admission Route” as derived from the database provided by NOCA. The comparison group, “Indirect Admission”, consisted of those patients who arrived at the operating hospital’s ED via transfer from another hospital where they initially presented. The control group, “Direct Admission”, were those patients who presented directly to the operating hospital’s ED. The data accessed on each patient was non-identifiable, and began with presentation to the initial hospital’s ED, and concluded on discharge from the managing trauma and orthopaedic surgery team’s hospital.

The outcomes of interest were a patient’s time to surgery, length of stay (LOS) and pressure ulcer development. Those with incomplete fields relating to the time and date of surgery were excluded. Time to surgery was derived from the date and time of presentation to their initial ED following hip fracture. Within the comparison group, cases were identified with a date entered for their initial ED presentation, but with no associated recorded time. Midnight of the date in question was used as the earliest time available for selection so as not to overestimate the time to surgery. LOS was calculated on the HIPE portal using the initial date of presentation and discharge date from the operating hospital. Pressure ulcer development was calculated from the corresponding IHFD data point, which recorded Stage 2 or higher of the “International National Pressure Ulcer Advisory Panel (NPUAP) – European Pressure Ulcer Advisory Panel (EPUAP) Pressure Ulcer Classification System” [8], that developed after admission and no later than 120 days thereafter.

Age, gender and American Society of Anaesthesiologists (ASA) physical status classification grade [9] were identified as confounders [10,11]. Surgery may be delayed due to the need for preoperative medical stabilization, diagnostic investigations, and a high dependency or intensive care unit bed to become available. Confounding factors were accounted and adjusted for in the analysis plan. It was anticipated that the rate of ED transfers was 10% that of direct admissions. The regression analysis compared “surgery within 48 hours”, as well as “length of stay” and “pressure ulcer development”, with five covariates. Using the rule of ten events per variable, for five covariates, at a rate of 10%, a minimal sample size of 500 was required. The resulting number of patients included was 3,893, which was adequately powered.

Continuous variables were presented as the mean \pm standard deviation (SD) and values across admission routes compared using independent t-tests. For continuous variables displaying evidence of skew, a median and range was presented, and non-parametric tests were used for comparison. “Time to surgery within 48 hours” was converted to a binary data point – “Time to Surgery Within 48 Hours” (yes / no). Categorical measures (e.g. gender, pressure ulcer development, surgery within 48 hours) were presented as a percentage and compared using chi-squared tests. A logistic regression model was used to investigate the effect of admission route on both the rates of surgery within 48 hours and pressure ulcer development, adjusting for age, gender and ASA grade. A linear regression analysis was performed to assess the effect of admission route and surgery within 48 hours (yes/no) on LOS adjusting for age, gender and ASA grade.

The analysis above was run for 2013 and 2014 data combined. A sensitivity analysis was performed to compare the two years of data, 2013 and 2014. The data was analysed using IBM SPSS Statistics Version 22, as licensed for the RCSI. Statistical significance was determined when $p < 0.05$.

Results

Between the 2013 and 2014 published IHFD data, 3,893 hip fracture cases were identified which were suitable for inclusion. 1601 (41.1%) of cases occurred in 2013, and 2292 (58.9%) in 2014. Indirect admissions via hospital transfer occurred in 336 cases (8.6%) and direct admissions in 3557 cases (91.4%). Descriptive statistics and unadjusted comparisons can be seen in Table 2. The mean age was 80.9 years old (range 60 – 104). The majority of all hip fractures occurred in female patients (73.0%), and were caused by low energy trauma (90.6%). The mean time to surgery was 45.0 hours (range 0.5 to 776.9). Surgery was performed within 48 hours in 2864 cases (73.6%) and beyond 48 hours in 1029 cases (26.4%). The mean LOS was 19.9 days (range 1 – 519). Pressure ulcers were diagnosed in 145 cases (3.7%).

The mean time to surgery for all indirect admissions was 47.9 hours and 44.7 hours for all direct admissions, which was not a statistically significant difference ($p=0.25$). Surgery was performed within 48 hours in 242 (72.0%) of indirect admissions and in 2622 (73.7%) of direct admissions, with no significance detected ($p=0.502$). The mean LOS for hospital transfers was 25.6 days and 19.6 days for direct admissions, which showed a statistically significant difference ($p<0.001$). Pressure ulcers were diagnosed in 11 (3.3%) of transferred cases and 134 (3.8%) of direct admissions, which did not show statistical significance ($p=0.648$).

Shown in Table 3 is a multivariate logistic regression that investigated the effect of admission route on rates of hip fracture surgery within 48 hours, adjusting for confounding factors. Patients admitted indirectly underwent delayed surgery more often than those admitted directly (OR 1.24, $p=0.102$), however this was not statistically significant. Older patients were more likely to have surgery beyond 48 hours (OR 1.01, $p=0.015$). Male patients underwent surgery beyond 48 hours more often than their females (OR 1.32, $p=0.001$). Patients who were ASA Grade 3 were significantly more likely than ASA Grade 1 (OR 2.32, $p<0.001$), as were ASA Grade 4 patients (OR 6.01, $p<0.001$), to undergo delayed surgery.

A linear regression analysis performed to assess the effect of admission route and rates of surgery within 48 hours on LOS adjusting for confounders is shown in Table 4. Patients admitted indirectly via hospital transfer experienced a significantly longer LOS than those admitted directly, with a mean difference of 5.99 days ($p<0.001$). Patients who underwent surgery beyond 48 hours experienced a statistically significantly prolonged LOS ($B=4.17$, $p<0.001$). An increasing age resulted in a statistically significant increase in LOS by 0.24 days for each advancing year ($p<0.001$). Male patients were more likely to experience a prolonged LOS than females ($B=2.24$, $p=0.021$). When compared to patients who were ASA Grade 1, those who were ASA Grade 2 experienced a statistically significant prolonged LOS ($B=4.07$, $p=0.027$), as did those who were ASA Grade 3 ($B=7.14$, $p<0.001$).

A logistic regression analysis of the effect of admission route, surgery within 48 hours and LOS on the development of pressure ulcers, adjusting for confounders, is shown in Table 5. There was no statistically significant difference in patients developing an ulcer between admission routes (OR 0.84, $p=0.588$). Patients who underwent surgery beyond the threshold of 48 hours were more likely to develop pressure ulcers (OR 1.54, $p=0.017$). An increasing LOS showed statistical significance with pressure ulcer development (OR 1.01, $p=0.002$). Patients who were ASA Grade 3 were statistically significantly more likely to develop a pressure ulcer (OR 12.04, $p=0.014$), as were those who were ASA Grade 4 (OR 18.70, $p=0.005$), when compared to those with an ASA Grade of 1.

There was an increase in the number of hip fracture patients captured by the IHFD as coverage of national hip fractures rates increased from 78% in 2013 to 84% in 2014. There was a significantly greater proportion of hospital transfers in 2013, as seen in Table 2, but no statistically significant effect of the year within which a patient sustained a hip fracture on their time to surgery, risk of pressure ulcer development or LOS.

Discussion

The hypothesis of this study was that patients with hip fractures in Ireland admitted indirectly experienced a longer time to surgery, prolonged length of stay and higher rates of pressure ulcers when compared to those admitted directly. Inter-hospital transfers were shown to predispose patients to a prolonged length of stay, but did not result in a longer time to surgery or a higher rate of pressure ulcer development.

Indirect admissions resulted in patients staying in the operating hospital 6 days longer than those admitted directly. In Ireland, such patients are admitted to hospitals with catchment areas that do not include their home address. Peripheral hospitals often do not have the same geriatric medical services, or access to step-down facilities, that larger referral centres do. Time delays occur before a safe discharge or transfer to a suitable convalescence or rehabilitation unit can occur, often with ongoing medical social work involvement. Prolonged inpatient lengths of stays for indirectly admitted patients can be minimised by establishing repatriation networks between the operating and the referring hospitals. A prolonged inpatient hospital stay puts the patient at risk of malnutrition and nosocomial infections, as well as slowing patients from passing through ED to an orthopaedic ward which negatively impacts patient flow, and carries economical implications for the health service [12,13]. Male patients with an increasing age and an ASA Grade of 2 or 3 were at an increased risk of sustaining a prolonging LOS. This at-risk cohort must be highlighted on admission and prioritised for convalescence and rehabilitation beds postoperatively.

LOS is used as a surrogate marker of the efficiency of a trauma service, and a prolonged LOS for a patient post hip fracture is seen as a determinant of dependency, with reduced chances of successful rehabilitation and the patient returning home [4]. An increased LOS post hip fracture can result in pressure ulcer development, delirium, institutionalization and urinary tract infections [14,6]. Nikkel et al. in New York showed that reducing a patient's LOS to within 14 days post hip fracture has been shown to improve mortality rates [15]. LOS for hip fractures in Ireland rose by 2.4% year on year between 2000 and 2009 to a rate of 1.55 times higher than other fragility fractures [16]. With the introduction of the IHFD, the mean LOS fell from 21 days in 2013 to 19 days in 2014 [1].

The total cost of an inpatient stay for a patient after a hip fracture has been calculated at £12,163, which works out at just over €14,300, with LOS contributing to 84% of this cost (or just over €12,000) [17]. Reducing the LOS of hospital transfer patients by admitting to the operating trauma and orthopaedic unit directly could result in savings of €72,000 per patient. A prolonged inpatient stay can be attributed to variations in medical complications, progress with rehabilitation, availability of step-down facilities and family support. Ambulance bypass, diversion protocols and repatriation networks exist in countries such as USA, Australia, Sweden and Iran [18,19]. The introduction of such much needed protocols and networks for hip fracture patients in Ireland would reduce the lengths of inpatient stays, and prove to be a cost saving intervention for the HSE. Investing in resources surrounding hip fracture care has been shown to have a beneficial economic effect whilst also improving outcomes [20].

Surgery beyond 48 hours has been shown to delay discharges, as described by Parker et al. [4,6]. The prolonged LOS seen in the indirect admission cohort suggests that they were exposed to the risks of delayed surgery, despite not being identified in this study. Following adjustment for age, gender and ASA grade, these transferred patients were 1.24 times more likely than directly admitted patients to undergo their surgery beyond 48 hours, however this did not show statistical significance. For patients admitted indirectly, the clock used to calculate time to surgery was often started when the patient was admitted to the operating hospital, as opposed to when they presented to the initial ED. Time delays that arose whilst performing the diagnostic X-ray, and awaiting blood results prior to the orthopaedic referral, were not captured in such cases. The differences relating to surgical timing seen in the results of this study, that showed no significance, were likely affected by the underestimation of the comparison group's time to surgery. National databases are known to contain incomplete data and inaccuracies, which can influence policy and budget planning [21-24]. With improved data collection in the initial presenting ED's, it is likely that the comparison group's time to surgery would have shown significant delays when compared to the control group.

There was no association found between the risks of developing a pressure ulcer and admission route, before or after adjusting for confounding factors. Surgery beyond 48 hours rendered a patient 1.54 times more likely to develop a pressure ulcer. LOS and an ASA Grade of 3 or 4 also had direct effects on increasing a patient's chance of developing such an ulcer. Patients at risk require identification on presentation to a hospital's ED, and need to be cared for on pressure relieving surfaces throughout their admission [1]. The IHFD reports a pressure ulcer when a grade 2 lesion or higher is seen, which was likely to have underestimated the incidence rates at 3.7% between the two years. Lefaivre et al. showed pressure ulcer development in 13.5% of hip fracture patients, and a significant effect of surgery beyond 48 hours on PU development (odds ratio 2.29,

p=0.0128) [25]. Ireland et al. described pressure ulcer development in 14.4% of cases, and showed that in each of these patients had a prolonged LOS by a factor of 30% [26]. The likely under-reporting of PU development in the IHFD is a cause for concern if this Blue Book Standard is to be assessed and benchmarked accurately.

Limitations of this study arise from the fact that HIPE data was assessed, which is a discharge-based as opposed to patient-based system. Exclusions arose from incompleteness in the recording of dates and times of presentation to the initial ED of the indirect admission cohort. The time to surgery was underestimated in the comparison group as a result of such omissions, which are well described in national hip fracture databases, and have affected research in the past [21-24]. Coverage of the IHFD rose from 78% in 2013 to 84% in 2014, which explains the increase in hip fracture numbers between the two years. Coverage rates are rising annually within the IHFD as the accuracy of the data provided by each hospital improves. Annual hip fracture audits have been shown to improve standards of care [27-29]. The IHFD will play a key part in Ireland's management of hip fractures as benchmarking incentivises trauma units to comply with the Blue Book Standards [3,30]. Future audit and research will depend on the validity of the database [21,22].

A national protocol is being devised for prehospital hip fracture diagnosis, in collaboration with the IITOS, similar to that based on good clinical practice of a history of a fall in an older person, who cannot weight bear, who demonstrates a shorted and externally rotated lower limb [31]. To date, it is hypothesised that the real potential of early surgical management of hip fractures is currently underestimated, and that timely intervention with established, validated hospital bypass protocols may show improvements as dramatic as proven in stroke and myocardial infarction [32,33,11]. Shabat et al described how increasing spending on resources to perform more surgeries for hip fractures within 48 hours has a beneficial economic effect, as well as improving outcomes [20]. The significantly prolonged LOS seen in hospital transfer patients has medical and social implications for the affected patients, as well as financial and capacity implications for the health service. The National Model of Care for Trauma and Orthopaedic Surgery has made a Key Recommendation to implement hospital bypass for trauma patients, and an immediate bypass protocol for fractured neck of femur patients [1]. The issue of prolonged LOS seen in the hospital transfer cohort must be addressed with enhanced repatriation links between hospitals within the incoming trauma networks.

Conclusion

Patients with hip fractures admitted indirectly via hospital transfer experience a prolonged length of stay of 6 days when compared to those admitted directly to the operating hospital. This elderly, frail cohort is exposed to increased perioperative morbidity and mortality rates, as well as reduced rehabilitation potential and less chance of returning home on discharge. It is not sustainable for such medical complications, reduced access to services and capacity restrictions to continue to exist within an already stressed Irish healthcare system. In line with the key recommendations of the National Model of Care for Trauma and Orthopaedic Surgery, a hospital bypass protocol for patients with hip fractures should be implemented to improve the quality, efficiency and cost effectiveness of the care provided.

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Conflict of Interest

The authors declare that they have no conflict of interest.

Ethical Approval

Ethical approval for the study was granted via the Research and Ethics Committee of the Royal College of Surgeons in Ireland (ID 001213).

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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