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RESEARCH ARTICLE 3

Predictors and outcomes of perioperative delirium in older females with fragility hip fractures at a tertiary care centre, Sri Lanka: A case-control study

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Abstract

Introduction: Hip fractures are common in older adults. Perioperative delirium is a common complication following a hip fracture. This study was designed to examine the predictors and outcomes of perioperative delirium following hip fracture in older females.

Methodology: This case-control study was conducted among inward patients in Colombo South Teaching Hospital who were admitted with hip fractures. Data were collected using an interviewer administered questionnaire. Cases were defined as female patients more than 65 years of age diagnosed with perioperative delirium and control group included female patients more than 65 years of age without delirium. Data were collected at two points; during hospital stay and one month following surgery. Data was analysed using SPSS 23.0.

Results: A total of 104 female patients were included (52 in each group). The average age of the study participants was 78.4 years. 53.8% had three or more medical co-morbidities and 64.4% had polypharmacy. The majority were indoor falls (n=69, 66.3%). The average time taken to reach the hospital was 75.5 hours, the mean time taken for the admission to the orthopaedic ward since arrival was 85.5 hours and the mean time to surgery from admission was 111.4 hours. High preoperative pain and having one or more falls during the last year were significantly associated with development of delirium. The cases were observed to have lower Barthel index score and lower level of mobility after 1 month.

Conclusions: Perioperative delirium is strongly associated with pre-operative pain and having one or more falls during last year. A significant waiting time for surgery and late admissions were noted during the study. Implementing protocols to optimize pain management, identification of factors leading to delay in admission and surgery will be potential future interventions for a better outcome.

Keywords: hip fracture, delirium, orthogeriatric, perioperative, fragility fracture

Introduction

Hip fracture is an increasingly common problem among older adults. It is being increasingly recognised as a growing problem in Asia as per the Asian Audit Report, 2009 [1]. With rising life expectancy worldwide, the number of elderly individuals is increasing in every geographical region, and the incidence of hip fracture is projected to rise from 1.66 million in 1990 to 6.26 million by 2050 [2]. Most of these fractures in elderly people are due to fragility fractures. Fragility fractures are defined as fractures that occur due to mechanical forces that would not ordinarily result in a fracture in a young, healthy adult [3]. Sri Lanka is facing a demographic transition and feminisation of the ageing population. Hip fractures are more frequently seen among older women. They have been associated with

high mortality and morbidity [4]. Timely admission to an ortho geriatric service, prompt admission to orthopaedic care, rapid comprehensive assessment, minimal delay to surgery, accurate and well-performed surgery, early mobilisation, and multidisciplinary rehabilitation are the key components of hip fracture care [5].

Delirium is a decline in previous cognitive function that develops over a short period of time. A meta-analysis of delirium in hip fracture patients reports an overall incidence of 24% [5], and causes are often multifactorial [6]. Delirium is associated with serious complications [7]. When superimposed on dementia postoperative delirium has been associated with two-fold increase in mortality [8]. Delirium was associated with increased duration of hospitalisation [9] and prolonged hospital stay leads to more complications and high health care costs.

Fragility hip fractures are common in Sri Lanka. In a recent study, it has been shown that in 2018, crude rate and standardised fragility hip fracture rates were 88.3 and 115.5 per 100,000-person years respectively [10]. An audit carried out in Sri Lanka in 2014 highlights the delayed surgery as a significant drawback in which 50% of patients underwent hip surgery after 7 days [11]. Delay in surgery has been shown to increase delirium after hip fracture [12]. Knowing whether there is a significant difference in the outcome of patients with delirium will be helpful for care planning and to achieve a better outcome. This study aimed to identify the possible risk factors and the possible outcomes of patients who develop delirium during the perioperative period.

Methodology

This case-control study was carried out at orthopaedic wards of Colombo South Teaching Hospital (CSTH) during the period of one year from 21st May 2021 to 21st June 2022. Three orthopaedic surgeons managed this unit, and geriatric assessment was done by the elderly care unit at CSTH. Elderly female patients (> 65 years) with a radiologically confirmed fragility fracture of the hip admitted for surgical treatment was recruited to the study.

Cases were defined as those with a fragility hip fracture who developed acute delirium by means of a positive confusion assessment method (CAM) screening test during the perioperative period. Those with a fragility hip fracture and a negative CAM screening test were defined as controls.

Patients with a prior history of severe cognitive impairment with prior documented Mini Mental State Examination Score < 10, Montreal Cognitive Assessment score < 10 or a history of severe or very severe dementia according to Dalhousie University classification and hip fracture patients managed conservatively were excluded.

With the expected exposure of 40% delirium among controls, with assumed odds ratio at 3 with a power of 0.8 and statistical significance calculated at confidence interval of 95%, for a case control study, the estimated sample size for cases is 52 while the estimated sample size for controls is 52, with a cumulative sample size of 104. When calculating the odds ratio several international studies were considered due to the absence of local studies in this regard [13,14].

All the patients admitted during this period who met the inclusion criteria were recruited until the desired number of patients was reached. The approval of the study protocol was obtained from the Ethical review committee in CSTH. Informed consent was obtained from patients, or the proxy consent was obtained from the next of kin in patients who did not have the capacity. The perioperative period was defined as the time from admission to discharge or death in case of an inhospital death. An interviewer administered questionnaire was designed according to the advice and guidance of an expert panel on geriatrics and orthopaedics. Demographic data, preoperative, intraoperative and post operative factors that might have correlation with delirium were collected. Delirium was recognised using the confusion assessment method. Follow up data was collected after 1 month using a telephone conversation. Data analysis was conducted using SPSS 23.0.

Results

The study population of 104 comprised exclusively females with 52 cases and 52 controls. The average age of study subjects was 78.4 years (SD ± 7.6). The majority were Sinhalese (n=84, 80.7%), married (n=98, 94.2%), most were looked after by a paid caregiver in the hospital (n=48,46.2%).

Hypertension was the most common comorbidity that was present in the majority (n=82, 78.8%) followed by diabetes mellitus (n=55, 52.9%). Almost all the patients were administered (n=102, 98.1%) oral paracetamol and tramadol as analgesics following admission to the hospital and were given regular (n=32, 30.8%) or as needed (n=37, 35.6%). Subcutaneous morphine was given to some patients.

Time taken for events following the fracture

The average time taken to the subjects for the admission to the emergency department since the fracture was 75.58 hours (SD± 15.54). The average duration from emergency department admission to admission to an orthopaedic ward was 85.5 hours (SD±47.5). The average time from admission to the emergency department to surgery was 111.4 hours (SD±38.52). Only 45.2% (n=47) of the subjects were brought to the hospital within 24 hours of the fall. Furthermore, 24 (%) patients were taken for surgery within 48 hours following admission to the hospital. Only 4 (%) patients had the surgery within 36 hours.

Table 1. Socio- demographic variables of the study population (N=104)

Age groups	n	%
60-74 years	34	32.7
75-84 years	43	41.3
85+ years	27	26
Total	104	100
Ethnicity	n	%
Sinhalese	84	80.7
Tamil	8	7.7
Muslim	11	10.6
Burger	1	0.96
Other	0	0
Marital status	n	%
Married	98	94.2
Unmarried	6	5.8
Total	104	100
In hospital caregiver	n	%
Children	24	23.1
Relative	4	3.8
Paid care giver	48	46.2
Other	28	26.9
Total	104	100

Table 2. Time spent on different events following the fall (N=104)

Timevariable	n	%
Time taken to come to the hospital < 24 hours	47	45.2
Time taken to perform the surgery after coming to the hospital < 48 hours	24	23.1

Preoperative pain was measured by both the visual analogue and Wong Baker scales. Both scales yielded nearly identical results, indicating that 65 (62.5%) of the study subjects experienced pain more than 6 on the scale. Most of the subjects were categorised as Clinical Frailty Score 4. Most patients were categorised as having mixed type of delirium (n = 30, 57.6%), while 18 (34.6%) subjects were categorised as having hypoactive 18 (34.6%). 4 (7.6%) subjects were categorized as having hyperactive delirium.

Give the number here (20.2%) of participants were reported to have mild dehydration, while 46 (44.2%) reported constipation during the pre-operative assessment. 55 (52.8%) of the patients were reported to be completely independent for activities of daily living with Barthel index of 100. 11 (10.5%) subjects had Barthel index less than 75. 96 (92.3%) patients had spinal anaesthesia while 6 (5.7%) of patients had general anaesthesia. Patients' mobility was assessed 1 month after surgery, and many were able to walk independently with the frame. The Barthel index cut-off point was taken here as those who scored a score of 75 and above, and below. The majority had a Barthel index score of less than 75 following the surgery. Six study subjects had died during their hospital stay. Fifteen (14.4%) had died within one month after hip surgery.

Predictors or associated factors of delirium

Predictors or associated factors of delirium were returned through cross-tabulation of the dependent variable (i.e. diagnosis of delirium) by different hypothesised predictors. All the variables that were discussed in the descriptive results were entered into the analysis. Number of drugs i.e. Polypharmacy ($\chi2 = 8.12$, $p < 0.01$) In-hospital caregiver ($\chi2 = 8.0$, $p < 0.05$), Mode of transport ($\chi2$, $p < 0.01$) Number of falls last year ($\chi2 = 13.4$, $p < 0.01$), Number of near falls ($\chi2 = 14.8$, $p < 0.05$) Pre-operative pain scores ($\chi2 = 56.2$, $p < 0.001$), Time taken to the surgery after admission to the hospital ($\chi2 = 25.9$, $p < 0.05$), frailty Score ($\chi2 = 6.5$, p , 0.05) were statistically significant with occurrence of delirium.

A multivariate analysis was performed by dichotomising the predictor variables by evidence-based cut-off points to convert the predictors to dummy variables. All variables were converted into categorical variables to perform a multiple logistic regression model.

The Omnibus statistical test, which assesses the overall predictability of the dependent variable by the independent variables, returned a $\chi2$ value of 106.171 with 12 degrees of freedom, which was significant at $p < 0.001$ level. The Test rejected the null hypothesis that no independent variable is linearly correlated to the log odds of the dependent variable proving the significance of the model.

Model fit confirmed by Hosmer Lemeshow test which returned a $\chi2$ value of 20.12 and $p = 0.60$. This indicated that $p \geq 0.05$, which directed to conclude that there isn't enough evidence to say that this model is a poor fit. The Cox and Snell R2 (0.64 and Nagelkerke pseudo R2 (0.853) indicated a strong relationship between the predictors and dependent variable. Classification table returned 50.0 overall correct percentage which was on the cut off value 50%.

The model identified 2 statistically significantly associated predictors of delirium when controlled for other variables. Therefore, a patient who had a fall during the last year (OR = 37.8, $p = 0.04$) and who had a pain score > 6 by any of the two pain scales (OR = 3933.5, $p = 0.002$) was more likely to develop delirium when controlled for other variables.

Relationship between delirium with the Barthel index in 1 month, level of mobility and post discharge complications were analysed by bivariate analysis using chi-square. A Barthel index > 75 (OR = 0.02) and Mobility score were significantly associated with delirium.

Table 3. Relationship between the dependent variable (Delirium) and selected predictor variables by binary logistic regression

Predictor variable	B	df	p	OR (Adjusted)	95% CI of OR	
Hospital Caregiver	-3.514	1	0.06	.030	.001-	1.17
Numbers of drugs >= 5(1)	-1.425	1	0.22	.240	.024-	2.41
Anaemia	.125	1	0.91	1.13	.112-	11.44
Transport by ambulance	-.177	1	0.86	0.838	0.12-	6.03
Falls during last year	**3.632**	**1**	**0.04**	**37.80**	**1.13-**	**1269.36**
Near falls during last year	-.896	1	0.53	0.41	.024-	7.02
Time_1(> 24 hours)	2.225	1	0.10	9.25	.64-	132.14
Time_2(> 48 hours)	.969	1	0.48	2.63	0.17-	40.20
Time_4(> 48 hours)	-.355	1	0.83	0.70	0.02-	20.05
Pain (> 6)	**8.277**	**1**	**0.002**	**3933.51**	**20.26-**	**763564.75**
Mobility Score (< 4)	14.774	1	0.99	260751.84	0.000-	-
Hearing impairment	.228	1	0.86	1.25	.087-	18.07
Frailty > 5	-.319	1	0.83	0.72	.040-	13.35

Comparison of the Barthel indexes between cases and controls

The sample means of the Barthel index values prior to and 1 month following surgery were calculated for cases and controls and were compared to identify any statistical difference between the cases and controls. The mean difference between initial Barthel indexes between the cases and controls was statistically non-significant (p=0.12, SE=2.13), indicating that the cases and control were derived from the same study population. However, following the development of delirium, a statistically significant difference was observed (p<0.0001, SE=3.8) between the 2 means of Barthel index values following 1 month of surgery between cases and controls.

Discussion

This study was aimed to examine the perioperative delirium, its risk factors, and outcomes in women admitted with fragility fractures of hip. In this study, we found that pain was the strongest predictor of perioperative delirium and having one or more falls during the last year was also significantly associated with delirium. Although several other variables were statistically significant with the occurrence of delirium in the initial bivariate analysis, multivariate logistic regression analysis didn't show a significant association

Assessment of pain in the presence of acute delirium can be difficult. We used both visual analogue scale and the Wong Baker scale to assess pain in this study to minimise this. Both scales yielded almost identical results, with 62.5% of the patients in the study reporting perioperative pain scores more than 6 on the scales indicating inadequate pain relief. Management of pain can be challenging as certain analgesic groups, such as NSAIDS can be more harmful in this situation due to the risk of perioperative renal, gastrointestinal side effects and effect on bone healing [20]. Excess use of opioids can contribute to the risk of delirium [21]. The most common analgesic protocol used in the study setting was regular paracetamol and tramadol, with as needed use of subcutaneous morphine. Tramadol is less potent than morphine in reducing pain and has been associated with a higher risk of delirium in some studies [21]. A fascia iliaca block had been recommended by NICE guidelines to be used preoperatively as a way of providing good analgesia [22] and was not practised in our study setting. This measure could reduce hip pain while minimising the systemic side effects of opioids. Modification of the usage of analgesics could be a potential area to focus on in future. In Scottish standards of care for hip fracture patients, provision of adequate pain relief has been identified as one of the "big 6" interventions in hip fracture care, where giving a nerve block in addition to opiate and non-opiate analgesia is recommended [23]. Structured pain management programs have been shown to reduce postoperative pain [26] and are associated with better outcomes of the rehabilitation process after a hip fracture [25].

The association between falls in the previous year and perioperative delirium had not been documented in the literature, but it is consistent with a possible link with frailty. Frailty is strongly associated with delirium and falls [26, 27].

In this study, patients with delirium were found to have significantly lower Barthel index and lower scores in the mobility scale after 1 month, indicating a more functionally dependent state. Poor functional outcomes in patients with acute delirium following a hip fracture have also been observed in previous studies [15, 16]. This indicates the importance of delirium prevention to gain a good outcome after a hip fracture.

Another highlight of this study was that patients presented to the hospital late and had a longer waiting

time until the surgery. The average time taken for the patients to be admitted to the emergency department since the fracture was 75.58 hours (SD± 15.54). The average time to perform surgery since admission was 111.4 hours (SD± 38.52). Current NICE guidelines recommend performing surgery within 36 hours of admission to the hospital [22]. Only 4 patients in the study population met this standard of care, and only 24 patients were taken for surgery within 48 hours following admission to the hospital. In our study setting due to limited availability of a bed in an orthopaedic ward, patients had to wait in the emergency department or were admitted to a general surgical ward until a bed was available in an orthopaedic ward, which added to the delay in performing surgery. The average duration to be admitted to an orthopaedic ward since admission to emergency department was 85.5 hours (SD ± 47.5). Many studies have shown that earlier surgery is associated with a shortened length of hospital stay in elderly patients with hip fractures [28]. Further studies are needed to investigate the factors related to delay in surgery and delay in admission in detail, aiming to improve this area in future. Possible other interventions include raising public awareness about the importance of early admission and surgery, improving collaborative work of medical, surgical, and anaesthetic teams, improving infrastructure in the orthopaedic wards to cater to more patients.

Patients were discharged early aiming for rehabilitation at home postoperatively (62% on postoperative day 2, 82% by the post-operative day 3), and delirium did not affect the length of hospital stay in our study. There is emerging evidence that perioperative delirium can lead to a higher likelihood of postoperative cognitive dysfunction, prolonged brain dysfunction, early dementia, and acceleration in cognitive decline. Patients can exhibit cognitive dysfunction weeks to months after the surgery [29,30]. In this study, we did not repeat the neurocognitive assessment prior to discharge, as it was considered too early for this assessment.

There are a handful of studies done related to perioperative care, complications and follow- up after a hip fracture. In one study done in the Teaching Hospital Karapitiya, where the focus of the study was to assess the functional level after a hip fracture, only 37.6% were physically independent (Barthel score of 100), 3 months after discharge (31). In our study, 32.7% of the study subjects had a Barthel index > 75 in one month, indicating majority had a lower Barthel index.

Limitations

The study was done during the COVID pandemic which could have affected the late presentation, and in- hospital delay in the surgery. At the time of the study there was no established orthogeriatric care pathway or an appointed geriatrician to provide orthogeriatric care.

Conclusions

Acute delirium following a fragility fracture of hip fracture in older women is strongly associated with preoperative pain and with having one or more falls during the previous year. Postoperative delirium was associated with poor 30-day functional outcome. Optimising protocols to provide better perioperative analgesia could be a potential intervention for the future.

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Criteria for authorship: Conception, Study design manuscript drafting Dr S.A.A Senevirathne, Samaraweera DN, Amarasinghe NK. data collection, analysis – Senevirathne SAA, Weerakoon DN, Angulugaha AGCM.

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