Management of delirium within intraoperative settings for older adults with hip fracture: a scoping review

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Title: Management of delirium within intraoperative settings for older adults with hip fracture: a scoping review.

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Title

Management of delirium within intraoperative settings for older adults with hip fracture: a scoping review.

Abstract

Background: Delirium is a common adverse event in older patients undergoing hip fracture repair surgery. The impact of hospital-acquired delirium during intraoperative phase of their treatment can have a significant impact on post-operative outcomes. While non-pharmacological, multicomponent delirium prevention interventions are considered standard practice in acute medical units, delirium management in the intraoperative setting is less clear.

Objectives: The aim was to identify evidence-based delirium management interventions which are, and could be, undertaken within the intraoperative setting for older patients undergoing hip fracture repair surgery.

Design: A scoping review following the principles developed by Arksey and O’Malley (2005).

Data Sources: Seven databases including Cochrane, CINAHL, Embase, Medline, PsychINFO, Pubmed and SCOPUS were systematically searched. The search was limited to the last 11 years (2009-2020). Research studies included both primary and secondary sources of evidence.

Results: A total of 2464 articles were initially identified. These articles were further refined using keyword searches and exclusion criteria, with a final set of 16 articles meeting the inclusion criteria. Three main themes were: anaesthetic related interventions used to prevent
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delirium; recognising non-modifiable and potentially modifiable risk factors; and screening and diagnosis of delirium.

Conclusions: While there is a strong focus on anaesthetist led interventions in the intraoperative setting, there are opportunities for more nurse-led interventions through adequate pain management and hemodynamic monitoring that require further research. Identifying the best test for screening and diagnosing delirium in the intraoperative setting requires further research.

*Tweetable abstract*

Nurse-led screening of older adults undergoing hip fracture surgery would help prevent postoperative delirium

*Keywords: Anaesthesia, delirium, hip fracture, intraoperative*
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Summary Box

What this paper adds

- Evidence for delirium management in the intraoperative setting is focused on anaesthetic choices and monitoring by anaesthetists.

- There are opportunities for the development, and evaluation, of interventions aimed at delirium prevention. These focus on clinical management of pain and blood pressure for older patients during the intraoperative phase.

- Further research into the ‘best’ instrument to screen and diagnose delirium in the intraoperative setting is required.
Introduction

The Australian Commission on Safety and Quality in Health Care (2016) asserts that around 19,000 older people are admitted to hospital following hip fracture annually. Hip fracture and advanced age (over 70 years) are risk factors for delirium within the intraoperative setting (Aldecoa et al., 2017; Inouye et al., 2015). Having a pre-existing cognitive impairment or dementia is also a significant risk factor for developing delirium (Morandi et al., 2017). The Australian and New Zealand Hip Fracture Registry (2019) found that 38% of individuals admitted with hip fracture had impaired cognition or known dementia on admission. In the immediate post-operative phase, the intraoperative environment is often high stimulus, which may contribute to the development of delirium (Rudolph & Marcantonio, 2011). It is not surprising then that given these contributing factors, delirium is one of the most common adverse events that can occur in people undergoing hip fracture repair, with reports of up to 26% of these patients developing a delirium (de Jong et al., 2019). Despite this, research has focused on other post-surgical adverse events such as those related to venous thromboembolism, infections and wound dehiscence (Sathiyakumar, 2015). For example, Johansen et al. (2017) examined current practices in the care of patients with hip fracture, noting that prevention activities focused on less common adverse events such as surgical wound infections rather than delirium. This is also noted by White et al. (2011) who discuss the dearth of evidence focused on delirium management in the intraoperative setting.

Individuals admitted for hip fracture repair must move through three areas of the operating theatre for surgical repair of the fracture, including holding bay, operating theatre and post anaesthetic care unit (PACU) (Barbeito et al., 2018). In a single centre prevalence study on older patients (over 70 years old) undergoing surgery such as orthopaedic, gastrointestinal and urinary procedures, 45% of individuals developed delirium within PACU (Neufeld et al., 2013). Further, 74% of participants whom were noted to have delirium at later
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stages of care in the surgical ward had been identified as having delirium within PACU (Neufeld et al., 2013). This study highlights the opportunity for prevention and early detection of delirium in the intraoperative phase of hip fracture repair surgery.

The intraoperative nursing role of managing older patients’ response to surgery has been described as using therapeutic relationships, clinical knowledge, and skills to promote patient safety and reduce distress (Rauta et al., 2013). A Delphi survey of expert nurses in the field of intraoperative nursing, which was conducted in Finland, found that patient safety was valued, with a focus on pain management, intraoperative patient positioning, sterile field maintenance, and monitoring physiological responses to surgery (Rauta et al., 2013). Due to the focus of nursing care on patient safety, the intraoperative nursing staff are well placed to prevent and manage delirium.

In their consensus-based guidelines, the European Society of Anaesthesiology have highlighted that intraoperative management of older patients during surgery is critical to preventing and managing delirium (Aldecoa et al., 2017). Level of sedation, management of blood pressure and adequate pain management are recognised as strongly associated with delirium and these can be addressed within the operative theatre (Aldecoa et al., 2017; Smith et al., 2017).

Due to the prevalence of delirium in older patients undergoing hip fracture surgery, and the opportunities for intervention in the intraoperative setting, delirium prevention and management activities within the intraoperative setting require further investigation. The aim of this scoping review was to describe the research evidence for delirium management interventions which are, and could be, undertaken in the intraoperative setting for older patients undergoing hip fracture repair surgery.

**Methods**

2.1 Search Strategy
The methodological framework developed in the seminal work by Arksey and O'Malley (2005) was utilised for this scoping review. As there was a sparsity of rigorous literature available in this patient population, a scoping review was selected because it can assist researchers to identify and articulate the current body of knowledge and any gaps in the field (Arksey & O'Malley, 2005). Guidelines for reporting scoping review were followed as per Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist (Supplementary File 1).

The research question was: What delirium management strategies are being, or could be, used within an intraoperative environment for older patients undergoing hip fracture repair? Keywords were used to search for articles published from January 2009 to June 2020. This time period was selected in order to examine data from one year prior to the publishing of the NICE guidelines for care of older people with cognitive impairment (National Institute for Health and Care Excellence, 2018). Databases searched included- Medline, CINAHL, PubMed, Cochrane, Psychinfo, and SCOPUS. In addition to this, reference lists of the final sources discovered were scanned for suitable sources. The approach to searching is presented in table 1.

[Insert Table 1 here]

2.2 Study selection

Study selection was guided by pre-determined inclusion and exclusion criteria. Inclusion criteria were:

1. Addressed the target question – focused on delirium management for patients undergoing surgical hip fracture repair;
2. Research article, qualitative, quantitative or mixed methods;
3. Published in the period 2009 till June 2020;
4. Sample included patients over the age of 65 years; and
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(5) Conducted in the intraoperative setting in a hospital.

Delirium management included interventions undertaken by healthcare staff focused on individuals at risk of, or experiencing, delirium, such as identify precipitating factors known to contribute to delirium. The intraoperative setting was limited to the immediate period before, during and after hip fracture repair surgery and defined as any area within an operating theatre ranging from initial pre-operative checks in holding bay to intraoperative procedures and in the immediate post-operative phase often known as “Post anaesthetic Care Units” or “Recovery Rooms”. Articles were excluded if they were not peer reviewed, grey literature, conference abstracts or quality improvement activities, or focused on ward-based delirium management.

All sourced articles were downloaded into Endnote© version 8, and duplicates were removed. Two researchers (LW, EC) then assessed articles relating to inclusion and exclusion criteria. A third member of the team (LG) provided a final decision on articles when there was disagreement.

2.3 Data extraction

The information from the articles including author, year, country, aim, method, sample, and findings were organised into an excel sheet. A thematic analysis approach was used to inductively analyse the literature (Braun & Clarke, 2006). Braun and Clarke (2006) devised a six-stage procedure for analysing data as follows-firstly immersion within the data, initial code generating, searching for themes, more involved review of themes, definition of themes and finally report writing. The articles were read, and the authors familiarised themselves with the data and discussed general initial ideas. An inductive approach was used. Firstly, the authors familiarised themselves with the data and discussed general initial ideas and made sense of information. Initial codes were developed using excel spreadsheets. Following this, four main categories were identified amongst the literature. Peer consensus
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was used to problem solve the categories and create clarity further refining to themes. The initial themes were summarised into an excel spreadsheet. Group consensus was used to develop the categories. The stages of thematic analysis were articulated via a series of updates to the excel spreadsheet.

[Insert Figure 1 Search process and outcomes]

**Results**

The initial database search yielded 2464 articles. The articles were progressively selected using the inclusion and exclusion criteria, as described in the PRISMA diagram (Refer to Figure 1). A total of 16 studies were included in this scoping review. The countries of origin included: Australia (n=1), Canada (n=1) China (n=1), Italy (n=2), Korea (n=1), Sweden (n=1), Serbia (n=1), Turkey (n=1), UK (n=2), USA (n=4), and there was one multicentre study which included six European countries and United States. There were five randomised controlled trials, two systematic reviews, five retrospective cohort studies, two retrospective case-control studies, prospective observational cohort study and one literature review. A summary of the articles is provided in Table 2.

[Insert Table 2 here]

Three themes were identified from the reviewed literature. The first theme identified anaesthetic related interventions to prevent delirium. Non-modifiable patient risk factors and modifiable intraoperative risk factors were identified in the second theme. The third theme focused on screening and diagnosis of delirium. There is necessarily an overlap between the themes, which reflects the complexity of delirium as a hospital-acquired complication. Rather than make specific recommendations for the practical management of older people at risk of, or diagnosed with, delirium in the intraoperative, only contributing factors to delirium prevention were investigated in the selected articles.

*Theme 1: Anaesthetic related interventions used to prevent delirium*
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Anaesthetist led delirium management strategies were primarily conducted by the attending anaesthetist during the surgical procedure of hip repair and included choice of anaesthesia, depth of anaesthesia, choice of anaesthetic reversal agents. Coburn et al. (2018) found that if general anaesthetic is used the choice between xenon versus sevoflurane (two inhaled anaesthetic agents) did not influence rates of delirium postoperatively. Other articles focused on spinal anaesthetic. Poeran et al. (2020) found spinal anaesthetic plus regional block was associated with lowering risk of delirium. This coincides with the Sieber et al. (2018) and Wang et al. (2015) studies, which both reported that a lighter sedation used with spinal anaesthesia and less variance with blood pressure reduced incidence of delirium. The findings from these two studies suggest a relationship with mean arterial pressure [MAP] and delirium, indicating that management of the intraoperative blood pressure is significant to optimise cognitive outcomes in older patients (Sieber et al., 2018; Wang et al., 2015).

Although there is a strong focus in the research on the choice of anaesthetic agents, specifically type of anaesthetic and reversal agents, there was no clear agent of choice in terms of reducing incidence and prevention of delirium (Coburn et al., 2018; Harris et al., 2019; Oh et al., 2016; Patel et al., 2018). Only one study showed an effect, this was the retrospective population-based cohort study by Ravi et al., (2019) which reported that general anaesthetic was shown to have an increased risk of delirium risk versus spinal anaesthetic (10.2% vs 11%).

**Theme 2: Recognising non-modifiable and potentially modifiable risk factors for delirium**

Both non-modifiable patient and modifiable clinical risk factors were identified. Non-modifiable risk factors may contribute to delirium development intraoperatively in individuals undergoing hip fracture repair surgery (Smith et al, 2017; Zhang et al., 2019). Dementia and cognitive impairment were identified as risk factors in four articles (Martocchia et al., 2015; Patel et al., 2018; Pioli et al., 2019; Smith et al., 2017), and as such,
needs to be considered when assessing risk prior to surgical intervention. The presence of dementia or cognitive impairment could be an influential factor in choice of anaesthetic.

Multiple comorbidities and subsequent frailty were identified as increasing individual risk of developing delirium following hip fracture and repair. Visual impairment and being over the age of 80 years of age were found to be risk factors for developing delirium in this patient cohort (Smith et al., 2017).

Multiple articles discussed potential contributors to delirium in individuals undergoing hip fracture repair that may be modified by medical and nursing interventions in the intraoperative setting. The relationship of very high and very low mean arterial blood pressure to contributing to delirium development was explored but no conclusive answer identified (Wang et al., 2015). Radinovic et al. (2019) demonstrated an association between the lowest intraoperative mean blood pressure, hypotension, blood pressure stability, and development of delirium. Patel et al. (2018) also concluded that lower blood pressures (associated with general anaesthetic) contribute to hypoperfusion and subsequently delirium.

Inadequate pain control was highlighted as a potential contributor to risk of delirium development (Chuan et al., 2020; Martocchia et al., 2015; Patel et al., 2018; Poeran et al., 2020; Uysal et al., 2020). However, control of pain with morphine in the post-operative period was found to triple the risk of developing delirium (Smith et al., 2017). Chuan et al. (2020) examined an analgesia bundle of care using femoral nerve blocks aimed at reducing multiple opioid use in particular intravenous morphine which showed reduced incidence of delirium in the intervention group. Unneby et al. (2020) hypothesised that providing adequate analgesia via femoral nerve block may reduce the incidence of delirium. However, according to Unneby et al. (2020) this protective factor may outweigh non-modifiable risk factor of dementia. No specific guides to pain management were provided in the reviewed articles.
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Prevention and management of infections are also considered as protective factors and identified as aspects that needed close assessment pre and post operatively (Smith et al., 2017). Particularly, respiratory and urinary infections are listed as increasing the chances of delirium developing in the post-operative phase (Smith et al., 2017). Martocchia et al. (2015) and Patel et al. (2018) discuss the contribution that hospital-related restraints such as indwelling urinary catheters, intravenous lines, traction, bed rails, and sequential compression devices may make to the development of delirium in the intraoperative setting.

Time to surgery and time/depth under anaesthesia were also considered modifiable risk factors. Ravi et al. (2019) found that with each increasing interval of time under anaesthesia, risk of developing delirium increased (6% for each 30 minutely interval). In relation to the time anaesthetised, the research identified the need for awareness of the medications used to reverse anaesthetic agents. In a retrospective case-control study, the probability of more effective neuromuscular reversal agents was hypothesised to lead to earlier and more effective extubating and therefore, less chance of hypoxic stressors (Oh et al., 2016). However, this could not be proven conclusively due to the high number of uncontrolled variables in this retrospective study (Oh et al., 2016).

Another modifiable risk factor is delayed to surgery for hip fracture repair. Delay to surgery is associated with increased the risk of intraoperative delirium (Patel et al., 2018; Pioli et al., 2019; Smith et al., 2017). Delay to surgery was related to scarcity of resources, for example on weekends and also patient factors such as requiring cardiac investigation prior to surgery (Ricci et al., 2015). Patel et al. (2018) mention time to surgery as a contributing risk factor for delirium; this supports the more recent study by Pioli et al. (2019), which found that delay to hip fracture repair surgery was an independent risk factor for development of delirium in patients with mild to moderate cognitive impairment.

Theme 3: Screening and diagnosis of delirium
Heterogeneity was noted with regards to screening and diagnosis of delirium within the various studies. There was variation in delirium screening tools for detection of delirium in participants. Nine articles utilised Confusion Assessment Method (CAM) as both a screening and diagnostic tool, but many articles used two or more tools. Two studies used MMSE (Mini-Mental State Examination) and CAM as diagnostic tools, as well as severity measures (Sieber et al., 2018; Wang et al., 2015). Whereas Coburn et al. (2018) used these tools both as screening tools for exclusion of participants and diagnostic tools following development of delirium in participants.

In addition, Mini-Mental State Examination (MMSE) is noted as a cognitive assessment tool in six articles, generally to exclude participants who are cognitively impaired (including delirium and dementia) or to assess baseline cognition (Coburn et al., 2018; Patel et al., 2018; Smith et al., 2017; Sieber et al., 2018; Unneby et al., 2020; Wang et al., 2015). Amongst the literature reviewed there were multiple other screening and delirium diagnostic tools used. Only two primary sources utilised experienced clinician diagnosis using the diagnostic criteria for delirium from the Diagnostic and Statistical Manual of Mental Disorders (Sieber et al., 2018; Zhang et al., 2019). Four studies excluded individuals with severe dementia, cognitive impairment and low MMSE scores (Coburn et al., 2018; Radinovic et al., 2019; Sieber et al., 2018; Wang et al., 2015). This research practice removes those at higher risk for delirium and may not be representative of the population undergoing treatment for hip fracture (Mosk et al., 2017).

**Discussion**

This review aimed to identify evidence-based delirium management interventions in the intraoperative setting for older people undergoing hip fracture repair surgery. While investigation into anaesthetic related interventions dominated the research literature, opportunities for early detection and prevention emerged through recognition of non-
modifiable and potentially modifiable risk factors. Finally, the heterogeneity of screening and assessment tools may confound evaluation of, and research into, delirium management.

In the reviewed studies, the choice of anaesthetic agents did not influence rates of delirium post-operatively. This finding resonates with a Cochrane review that aimed to outline which choice of anaesthetic (regional versus general) was best for patients undergoing hip fracture repair, however the evidence base was not of a high enough quality to allow for a conclusive recommendation (Guay et al., 2016).

The focus on anaesthetic choices within the intraoperative setting for delirium management appears to indicate limited engagement in delirium prevention by staff from other disciplines. A multidisciplinary approach to delirium management is recommended as best practice to manage delirium (Australian Comission on Safety and Quality in Health Care, 2016) and could provide new lines of inquiry for research in the perioperative setting. Orthopaedic surgeons, geriatricians, and nurses are almost absent from the reviewed literature. When considering that these staff are vital contributors at the bedside to the intraoperative management of patients undergoing hip fracture repair it is surprising. Exploratory research into the role these clinicians take with regards to delirium management is recommended.

Dementia and other forms of cognitive impairment were identified as a non-modifiable risk factors for delirium development. Despite this, there were no research studies investigating the effect of non-pharmacological strategies such as a family member staying with the person in the waiting bay, knowing the patient’s interests to facilitate meaningful chatter, or investigating environmental factors. Nor were any descriptions of the intraoperative journey for older patients living with dementia undergoing hip fracture repair surgery found in this review. Dementia is rising internationally, with over 50 million people living with dementia in 2019 (Alzheimer’s Disease International, 2019). These numbers are
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estimated to increase to upwards of 152 million by 2050 (Alzheimer’s Disease International, 2019) and people with dementia are highly likely to present for hip fracture repair surgery. This is an area for urgent investigation.

Reducing pain, optimal haemodynamic management and shorter time to theatre may prevent delirium. Through the conduct of this review, we suggest that there are opportunities for interdisciplinary innovation in delirium management in the intraoperative setting. Collaborative approaches to managing pain and blood pressure monitoring throughout the intraoperative journey could be reviewed and evaluated, focusing on delirium incidence. This is an area for future research.

Nursing staff have a significant role to perform in relation to managing time to surgery for hip fracture repair. Nurses are responsible for patient flow within the intraoperative setting including bookings, movement through stages of theatre & surgical wards and supply and set up of equipment (Amato-Vealey et al., 2012). Further investigation into these procedures and possible barriers and facilitators to movement through theatre in relation to delirium incidence may offer another avenue for prevention research.

There were many screening tools identified in the review, with no clear recommendation that any screening tool is superior to others, which made direct comparison of studies difficult. It is important to note that many studies used screening tools as their diagnostic criteria for delirium which may not be as accurate as more in-depth neuropsychiatric testing (San et al., 2017). Information on how a diagnosis of delirium is made in the intraoperative setting was generally limited. This is articulated well in the systematic review by Patel et al. (2018) where it was found that choice of anaesthetic and its influence on development of delirium in this patient population cannot be accurately established due to heterogeneity and differing delirium assessment tools used as the primary outcome.
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In summary, there are significant opportunities for interdisciplinary approaches to delirium prevention and management in the intraoperative setting. Exploration of person-focused strategies that support people living with dementia or cognitive impairment during the journey are urgently required. Strategies for how to manage the person who develops delirium in the intraoperative setting were not identified. How delirium is managed as the person emerges from anaesthetic sedation requires description so that this area of practice can be evaluated and explored for innovation.

Limitations

This scoping review was limited to literature that was peer-reviewed. Initial early searches within the grey literature suggests that there may be other sources of evidence available. Additionally, consistent with the aim of a scoping review, the rigour of the research has not been evaluated. As more literature on the subject emerges the potential for a systematic review should be explored.

Conclusion

Delirium management in the intraoperative setting is emerging as an area for further development and research. Leadership from nursing around non-modifiable and modifiable risk factors is recommended. Nurse-led research exploring person-focused care strategies for people living with dementia, pain management, haemodynamic monitoring and management, and environmental matters, including patient flow, is recommended. Outcome measures for delirium need to be consistent across studies, and the Confusion Assessment Methods appears to be a useful measure for further evaluation in this setting.

Conflict of interest.

No conflicts of interest to disclose.

Funding sources
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None.

Ethical approval

None.
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References


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Figure 1: Search process and outcomes

- Records identified through database searching (n = 2464)
- Records after duplicates removed (n = 1525)
- Records screening using terms delirium & surg* in title & Fractur* in abstract (n = 80)
- Articles refined using exclusion criteria (n = 23)
- Full-text articles assessed for eligibility via peer discussion (n = 16)
- Studies included in scoping review (n = Total 16)

Full-text articles excluded, due to exclusion criteria (n = 57):
1. Not hip fracture
3. Not intraoperative
9. Not management
3. Study protocol only
1. Duplicate
6. Conference abstract

Records excluded (n = 7):
4. Conference abstract
1. Not available English
1. Not intraoperative
1. Duplicate

<table>
<thead>
<tr>
<th>First author, year (country)</th>
<th>Aim</th>
<th>Methodology</th>
<th>Sample</th>
<th>Findings</th>
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<tbody>
<tr>
<td>Chuan, 2020 (Australia)</td>
<td>To examine the application of an analgesia care bundle to reduce delirium incidence.</td>
<td>Prospective case/control study</td>
<td>300 Patients with hip fracture surgery Control- 70% female Mean age 85 years Care bundle 71% female Mean age 82 years</td>
<td>A reduction in the incidence of delirium on the third postoperative day in the care bundle group compared with the control group: 33 patients (22%) vs. 49 patients (33%). Showed evidence that multimodal, multidisciplinary analgesic care bundle implemented throughout patient surgical journey may reduce incidence of delirium.</td>
</tr>
<tr>
<td>Coburn, 2018 (USA &amp; Europe)</td>
<td>To evaluate xenon anaesthesia for the prevention of postoperative delirium</td>
<td>Randomised controlled trial</td>
<td>256 patients with hip fracture surgery 75% female Mean age 84 years</td>
<td>Xenon anaesthesia did not significantly reduce the incidence of POD after hip fracture surgery. Some evidence to suggest depth of anaesthesia influences risk of postoperative delirium.</td>
</tr>
<tr>
<td>Harris, 2019 (USA)</td>
<td>To identify potentially modifiable risk factors which influence morbidity and mortality in older patients undergoing hip fracture repair</td>
<td>Retrospective cohort study of national database</td>
<td>1261 patients with hip fracture surgery 74% female 68% aged &gt;80 years</td>
<td>Baseline dementia and inability to sign surgical consent are significant risk factors for adverse outcomes after hip fractures and should be considered in the informed consent process. Faster time to surgery was a protective factor.</td>
</tr>
<tr>
<td>Martocchia, 2015 (Italy)</td>
<td>Present the current research in relation to hip fracture surgery</td>
<td>Presentation of literature</td>
<td>Nil presented</td>
<td>An integrated approach combining environmental and pharmacological strategies is useful in the delirium treatment, with a close</td>
</tr>
<tr>
<td>Study (Year &amp; Location)</td>
<td>Objective</td>
<td>Study Design</td>
<td>Number of Participants</td>
<td>Details</td>
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<tr>
<td>Oh, 2016 (Korea)</td>
<td>Explore the effects of sugammadex on postoperative delirium in elderly patients who underwent hip fracture surgery.</td>
<td>Retrospective chart audit</td>
<td>174 patients with hip fracture surgery</td>
<td>Sugammadex did lower risk of hypoxia but did not reduce the incidence of post-operative delirium. Sugammadex completely reverses neuromuscular block without cholinergic side effects and reduces the frequency of postoperative pulmonary complications and hypoxia compared to conventional cholinesterase inhibitors.</td>
</tr>
<tr>
<td>Patel, 2018 (UK)</td>
<td>What is the effect of regional versus general anaesthesia on postoperative delirium in elderly patients undergoing surgery for hip fracture?</td>
<td>Systematic literature review</td>
<td>104 articles</td>
<td>No evidence to suggest anaesthesia types influence postoperative delirium. Highlighted influencing factors: co-morbidities, blood pressure swings, time.</td>
</tr>
<tr>
<td>Pioli, 2019 (Italy)</td>
<td>To investigate the relationship between onset of delirium and time to surgery in hip fracture patients with</td>
<td>Retrospective chart audit</td>
<td>939 patients with hip fracture surgery</td>
<td>Delayed time to surgery reduced cognitive outcomes. Older adults, comorbidities, functional impairment increased risk of delirium.</td>
</tr>
</tbody>
</table>
Poeran, 2020 (USA)  
To examine the relationship between delirium and intraoperative modifiable risk factors in older patients undergoing hip fracture repair  
Retrospective chart audit  
505152 patients with hip fracture surgery  
70% female  
Mean age 83 years  
Types of anesthesia, delirium contributing drugs and opioids contributed to delirium. Adequate pain control may be a protective factor against delirium (both opioid and spinal plus regional blocks).

Radinovic, 2019 (Serbia)  
To examine the impact of blood pressure control intraoperatively on postoperative delirium  
Prospective observational cohort  
148 patients with hip fracture surgery  
Mean age 75 years (no delirium)  
Mean age 81 years (delirium)  
Higher mean arterial blood pressure has protective factor on delirium. Intraoperative hypotension, low minimum, low pulse pressure and mean arterial blood pressure fluctuation all contribute to delirium. Even single episode of blood pressure drop during surgery may increase incidence of delirium.

Ravi, 2019 (Canada)  
Explore duration of time to hip fracture surgery to determine whether prolonged surgical times and type of anesthesia are associated with an increased risk of  
Retrospective chart audit  
68131 patients with hip fracture surgery  
71% female  
Mean age 84 years  
Prolonged surgical duration in hip fracture patients was associated with an increased risk for postoperative delirium, as was the use of GA.
<table>
<thead>
<tr>
<th>Study</th>
<th>Design</th>
<th>Sample Size</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smith, 2017 (UK)</td>
<td>Systematic review and meta-analysis</td>
<td>32 studies</td>
<td>6702 patients with hip fracture surgery. There is evidence to predict post-operative delirium based on age, cognitive impairment, comorbidities and infection.</td>
</tr>
<tr>
<td>Sieber, 2018 (USA)</td>
<td>Randomised controlled trial</td>
<td>200 patients with hip fracture surgery</td>
<td>Mean age 82 years, 73% female, Lighter sedation 72% female, Heavier sedation 74% female. Sedation did influence delirium. Baseline comorbidities obscure the effects of lighter sedation in reducing delirium.</td>
</tr>
<tr>
<td>Unneby, 2020 (Sweden)</td>
<td>Randomised controlled trial</td>
<td>236 patients with hip fracture surgery</td>
<td>Mean age 84 years, 46% have dementia. Despite less preoperative pain and need of opioids, femoral nerve block did not reduce the incidence of complications postoperatively. However, a preoperative femoral nerve block may result in less preoperative delirium, but this requires further investigation.</td>
</tr>
</tbody>
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patients with hip fracture, including those with dementia.

<table>
<thead>
<tr>
<th>Study</th>
<th>Design</th>
<th>Participants</th>
<th>Intervention</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uysal, 2020 (Turkey)</td>
<td>Randomised controlled trial</td>
<td>91 patients with hip fracture surgery</td>
<td>Intermittent femoral nerve block vs paracetamol</td>
<td>Intermittent femoral nerve block more effective in preoperative pain management of trochanteric femur fracture &amp; preventing pain during regional anesthesia application. Mean IL-8 level was lower in the femoral nerve block group when compared to the paracetamol group. Delirium incidence was lower in the intervention group but numbers not statistically significant.</td>
</tr>
<tr>
<td>Wang, 2015 (USA)</td>
<td>Retrospective chart audit</td>
<td>103 patients with hip fracture surgery</td>
<td>Higher and lower Mean arterial blood pressure was associated with significant risk of postoperative delirium</td>
<td>The association between intraoperative blood pressure and postoperative delirium in elderly hip fracture patients</td>
</tr>
</tbody>
</table>
Zhang, 2019 (China)  
To evaluate the risk factors for the development of postoperative delirium and design a predictive nomogram for the prevention of delirium in patients with hip fracture.  
Retrospective observational cohort study & predictive tool design  
825 patients with hip fracture surgery  
72% female  
Mean age 79  
Independent risk factors for developing delirium within 6 months of surgery were identified using multivariable logistic regression analyses. Cognitive impairment, multiple co-morbidities (frailty), higher ASA score, significant blood loss, and admission to ICU all associated with increased risk of delirium. A predictive nomogram model was built based on the results.