Incidence and predictors of postoperative delirium in the older acute care surgery population: a prospective study

Bianka Saravana-Bawan, MD
Lindsey M. Warkentin, MSc
Diana Rucker, MSc, MD
Frances Carr, MD
Thomas A. Churchill, PhD
Rachel G. Khadaroo, MD, PhD

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Correspondence to:
R. Khadaroo
University of Alberta Hospital
2D3.77 Walter C. Mackenzie Health Sciences Centre
8440 - 112 St NW
Edmonton AB T6G 2B7
khadaroo@ualberta.ca

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Background: Among older inpatients, the highest incidence of delirium is within the surgical population. Limited data are available regarding postoperative delirium risk in the acute care surgical population. The purpose of our study was to establish the incidence of and risk factors for delirium in an older acute care surgery population.

Methods: Patients aged 65 years or more who had undergone acute care surgery between April 2014 and September 2015 at 2 university-affiliated hospitals in Alberta were followed prospectively and screened for delirium by means of a validated chart review method. Delirium duration was recorded. We used separate multivariable logistic regression models to identify independent predictors for overall delirium and longer episodes of delirium (duration ≥ 48 h).

Results: Of the 322 patients included, 73 (22.7%) were identified as having experienced delirium, with 49 (15.2%) experiencing longer episodes of delirium. Postoperative delirium risk factors included Foley catheter use, intestinal surgery, gallbladder surgery, appendix surgery, intensive care unit (ICU) admission and mild to moderate frailty. Risk factors for prolonged postoperative delirium included Foley catheter use and mild to moderate frailty. Surgical approach (open v. laparoscopic) and overall operative time were not found to be significant.

Conclusion: In keeping with the literature, our study identified Foley catheter use, frailty and ICU admission as risk factors for delirium in older acute care surgical patients. We also identified an association between delirium risk and the specific surgical procedure performed. Understanding these risk factors can assist in prevention and directed interventions for this high-risk population.

Contexte : Parmi les patients âgés, l'incidence la plus élevée d'épisodes de délire s'observe chez les patients opérés. On dispose de données limitées au sujet du risque de délire postopératoire chez les patients soumis à une chirurgie d'urgence. Le but de notre étude était de connaître l'incidence des épisodes de délire et les facteurs de risque chez la population âgée soumise à une chirurgie d'urgence.

Méthodes : Nous avons suivi de façon prospective les patients de 65 ans ou plus soumis à une chirurgie d'urgence entre avril 2014 et septembre 2015 dans 2 centres hospitaliers universitaires de l'Alberta et nous avons recensé les épisodes de délire au moyen d'une méthode validée d'analyse des dossiers. La durée des épisodes de délire a été notée. Nous avons utilisé des modèles séparés d'analyse de régression logistique multivariée pour dégager les prédicteurs indépendants des épisodes globaux de délire et des épisodes plus longs (durée ≥ 48 h).

Résultats : Parmi les 322 patients inclus, 73 (22,7 %) ont manifesté un épisode de délire, dont 49 (15,2 %) un épisode plus long. Les facteurs de risque à l'égard des épisodes de délire postopératoire ont inclus : l'emploi d'une sonde Foley, la chirurgie intestinale, la chirurgie de la vésicule biliaire, l'appendicectomie, un séjour à l'unité de soins intensifs (USI) et un état de fragilité léger ou modéré. Les facteurs de risque à l'égard d'un épisode de délire postopératoire prolongé ont inclus : l'emploi d'une sonde Foley et un état de fragilité léger ou modéré. L'approche chirurgicale (ouverte c. laparoscopique) et la durée globale de l'intervention n'ont pas joué un rôle significatif.

Conclusion : Faisant écho à la littérature publiée, notre étude a identifié l'emploi de la sonde Foley, l'état de fragilité et le séjour à l'USI comme des facteurs de risque de délire chez les patients âgés soumis à une chirurgie d'urgence. Nous avons aussi observé un lien entre le risque de délire et certains types d'interventions chirurgicales. En comprenant mieux ces facteurs, il sera possible de prévenir ces épisodes et d'orienter les interventions chez cette population à risque élevé.

Delirium is characterized by acute, fluctuating alteration in mental function and disturbance in attention.[1] The duration of delirium can be prolonged, and cognitive impairment can last up to a year.[2] The cause of delirium is believed to be multifactorial. Previously identified risk factors include both nonmodifiable predisposing factors (such as illness severity, surgery and admission to the intensive care unit [ICU]) and modifiable precipitating risk factors (such as immobility and presence of invasive tubes).[3–5] Older surgical patients (≥ 65 yr) are particularly vulnerable to delirium owing to advanced age and greater rates of frailty.[6]

The incidence of delirium has been noted to be as high as 60% in all inpatients and 7%–35% within the general surgery population.[6–11] The consequences of delirium result in substantial health care expenditure owing to a prolonged hospital stay and increased disability, necessitating escalated levels of care at discharge.[12–15] Delirium is also associated with increased mortality rates during the hospital stay and substantially increased overall 6-month and 1-year mortality rates.[16,17]

The vast majority of the literature on delirium in the surgery population is based on orthopedic and cardiovascular populations, with a limited literature base evaluating the general surgical population. Almost all of the general surgery literature pertains to the elective population, with few published papers evaluating the incidence and risk factors for delirium in the acute care surgery (emergency nontrauma general surgery) population. The limited data available suggest that the older acute care surgery population has a higher rate of postoperative delirium than the overall acute care surgery population, ranging from 18% to 55%.[11,18] Given that older people represent the most rapidly increasing segment of the population and that a third of inpatient operations are being performed in older patients, it is vital to determine the risk factors for delirium in this population, particularly since delirium is preventable in 30%–40% of cases.[13,19–21] By identifying risk factors, targeted preventive measures can be implemented.

The purpose of our study was to determine the incidence of postoperative delirium and of longer episodes of delirium, and examine the association of delirium with pre- and perioperative risk factors in an older acute care surgery population.

Methods

Setting and participants

The study cohort comprised patients recruited from the Elder-friendly Approaches to the Surgical Environment (EASE) study; details of the EASE study, including design and analytic plan, have been previously described.[22] In brief, this prospective concurrently controlled paired study was designed to assess the impact of an elder-friendly surgical unit on clinical, humanistic and economic outcomes. The participants included in the current analysis were all patients within the pre–EASE-initiative cohorts at the University of Alberta Hospital, Edmonton, and the Foothills Medical Centre, Calgary, who had been recruited between April 2014 and September 2015. Patients were included if they were 65 years of age or more, were admitted directly to the acute care surgery service and underwent acute abdominal surgery. Patients who underwent elective, palliative or trauma surgery, were not residents of Alberta, or were dependent in 3 or more activities of daily living were excluded. Ethics approval was obtained from both the University of Alberta Research Ethics Board and the University of Calgary Conjoint Research Ethics Board.

Measurements

Data were collected via chart review and patient interview and included age, sex, race, body mass index, marital status, smoking status, previous comorbidities, living situation before admission and Clinical Frailty Scale score.[23,24] Frailty scores were further condensed into 3 categories: very fit/well, managing well/vulnerable, and mildly or moderately frail. In all patients, a Charlson Comorbidity Index score was calculated at admission. Preoperative hemoglobin concentration, length of time in the operating room, pre- or intraoperative Foley catheter placement, American Society of Anesthesiologists physical status classification score and postsurgery admission to the ICU were also captured. The patients' operative procedure was classified based on the "surgery area" and included appendix (open or laparoscopic appendectomy), gallbladder and biliary tract (open or laparoscopic cholecystectomy), hernia (nonelective hernia repair) or other gastrointestinal (lysis of adhesions, small bowel resection, hemi- or total colectomy, colostomy/ileostomy creation or revision, or other gastrointestinal surgery confirmed by the study team).

Delirium measure

The Inouye chart review method was used to screen for delirium.[25] This validated chart-based instrument has a sensitivity of 74% and a specificity of 83% compared with the gold-standard Confusion Assessment Method.[26] Abstractors reviewed the full charts (including progress, nursing and consultant notes) for key terms indicating acute mental status change. If the result was positive for an acute confusional state, further information regarding the information source, onset and duration of the episode, and evidence of reversibility were collected.

Statistical analysis

We calculated descriptive statistics. We built separate multivariable logistic regressions to identify covariate-adjusted

independent predictors of delirium and of longer episodes of delirium (acute confusional state lasting ≥ 48 h). Covariates assessed in the regression included age, smoking status, comorbidities on admission, living situation before admission, Clinical Frailty Scale score, American Society of Anesthesiologists classification score, operative procedure, operative technique (open or laparoscopic), duration of surgical procedure, Foley catheter use and postoperative admission to the ICU. We added covariates to each model only if the covariate was found to be statistically significant ($p < 0.05$) on univariate analysis, was deemed important based on the literature and expert opinion, or was associated with confounding based on a 10% or greater change in the β coefficient within the model irrespective of statistical significance. No variables forced into the models. The p value for statistical significance for all comparisons was < 0.05. We did not perform any adjustments for multiple testing, as the analysis was intended to be exploratory. We selected the most efficient models (in which all variables had a p value < 0.05) and judged them for fit using the Hosmer–Lemeshow goodness-of-fit test; we determined accuracy using receiver operating characteristic curves. We used Stata/SE-13 (StataCorp) for all analyses.

Results

The baseline characteristics of the 322 patients included in this analysis are shown in Table 1. The overall mean age for this cohort was 76.1 (standard deviation [SD] 7.66) years, with 146 patients (45.3%) being women, 238 (73.9%) being white, 232 (72.0%) living at home without support, and 78 (24.2%) having mild to moderate frailty. The most common operation was intestinal (142 patients [44.1%]), with gallbladder and biliary tract being second most common (75 patients [23.3%]). The overall mean length of stay was 13.7 (SD 17.0) days (range 1–105 d).

The incidence of delirium in our study population was 22.7% (73/322). The mean duration of delirium was 1.75 (SD 0.60) days, with the initial report of delirium usually occurring within the first 48 hours after surgery (53 patients [73%]). Compared to patients without delirium, delirious patients were frailer ($p < 0.001$) and more likely to have cardiovascular disease ($p = 0.04$), dyslipidemia ($p = 0.02$), previous cognitive impairment ($p = 0.004$) and respiratory problems ($p = 0.04$). Delirious patients were taking significantly more medications than patients who did not experience delirium (mean 5.85 [SD 3.80] v. 4.57 [3.44], $p = 0.003$), had longer operation times (127 [SD 60.7)] min v. 106 [SD 54.8] min, $p = 0.001$) and were more likely to have had a Foley catheter inserted before or during surgery (64 [87.7%] v. 153 [61.4%], $p < 0.001$) (Table 1).

Significant independent risk factors for delirium included Foley catheter use (odds ratio [OR] 3.37, 95% confidence interval [CI] 1.36–8.35), intestinal surgery (OR 4.74, 95% CI 1.86–12.08), gallbladder or biliary tract surgery (OR 4.48, 95% CI 1.41–14.17), appendix surgery (OR 5.26, 95% CI 1.40–19.75), ICU admission postoperatively (OR 1.37, 95% CI 1.06–1.78) and mild to moderate frailty (OR 4.50, 95% CI 1.76–11.50).

Longer episodes of delirium occurred in 49 patients (15.2% of the overall cohort and 67% of those with delirium). There were no statistically significant differences in patient characteristics between patients with short delirium episodes and those with longer episodes. Foley catheter use (OR 4.48, 95% CI 1.76–11.50) and mild to moderate frailty (OR 7.77, 95% CI 2.18–27.65) were statistically significant independent risk factors for longer episodes of delirium (Table 2).

Discussion

There are limited studies investigating delirium in the acute care surgery population, and, to our knowledge, no studies that specifically assess type of emergency surgery performed as a risk factor. Consequently, the current study provides necessary assessment of this surgical population. We found that Foley catheter use, ICU admission, frailty, and biliary tract surgery, intestinal surgery and appendectomy were significant independent risk factors for postoperative delirium in the acute care surgery population. In patients with longer episodes of delirium, only Clinical Frailty Scale score and Foley catheter use were found to be significant.

The overall incidence of delirium in our study was 23%, which is consistent with the literature. Studies in elective (nonacute) general surgery populations document delirium rates of 7%–35%, with a mode of 16% or less. In acute care surgical populations, rates of delirium of 18%–55% have been reported, with a mode over 20%.[6,8,9,11,12,18,27–30] The wide range of delirium incidence in the literature is likely due to variations in patient populations, most notably the inclusion of patients with baseline cognitive deficits and neuropsychiatric disorders owing to different inclusion and exclusion criteria. Nonetheless, our data show a consistent trend of a higher incidence of delirium in the acute care surgical population than in the elective general surgical population. The difference may be related to differences in the patient population, as elective patients undergo preoperative screening and medical optimization. This high rate of delirium may also in part explain the higher incidence of illness and death among older people who undergo acute care surgery.[31]

Our results indicate that surgery for appendiceal and biliary disease in addition to bowel resection is a risk factor for postoperative delirium. In comparison, procedures such as hernia repair, both inguinal and abdominal, were not associated with an increased rate of postoperative delirium. We postulate that this association may be related to the fact that the underlying disease in these cases in mostly infectious and inflammatory. This conclusion is consistent with the finding that higher rates of postoperative delirium

Table 1. Baseline characteristics of older (age ≥ 65 yr) acute care surgical patients according to delirium status

Characteristic	No delirium, no. (%) of patients* *n* = 249	Delirium, no. (%) of patients* *n* = 73	
		All episodes	Longer episodes† *n* = 49
Age, yr, mean ± SD	75.7 ± 7.7	77.5 ± 7.4	77.8 ± 7.6
Female sex	113 (45.4)	33 (45.2)	24 (49.0)
White	176 (70.7)	62 (84.9)	38 (77.6)
Body mass index, mean ± SD	27.3 ± 6.0	26.4 ± 6.4	26.2 ± 7.0
Smoker	29 (11.6)	11 (15.1)	8 (16.3)
Living situation			
Home without support	189 (75.9)	43 (58.9)‡	28 (57.1)‡
Home with informal caregiver	48 (19.3)	23 (31.5)‡	15 (30.6)‡
Supportive living/long-term care	11 (4.4)	6 (8.2)‡	5 (10.2)‡
Missing	1 (0.4)	1 (1.4)‡	1 (2.0)‡
Clinical Frailty Scale			
Very fit/well	63 (25.3)	9 (12.3)‡	3 (6.1)‡
Managing well/vulnerable	141 (56.6)	31 (42.5)‡	24 (49.0)‡
Mildly or moderately frail	45 (18.1)	33 (45.2)‡	22 (44.9)‡
Charlson Comorbidity Index score, median (interquartile range)	0 (0–2)	1 (0–3)‡	1 (1–2)‡
Past medical history			
Cardiovascular disease	65 (26.1)	28 (38.4)‡	19 (38.8)‡
Diabetes	50 (20.0)	14 (19.2)	12 (24.5)
Dyslipidemia	57 (22.9)	27 (37.0)‡	17 (34.7)‡
Cognitive decline	4 (1.6)	6 (8.2)‡	4 (8.2)‡
Sensory impairment	9 (3.6)	7 (9.6)‡	5 (10.2)‡
Respiratory problem	56 (22.5)	25 (34.2)‡	15 (30.6)‡
American Society of Anesthesiologists classification score, mean ± SD	2.6 ± 0.74	3.1 ± 0.78‡	3.1 ± 0.73
Total no. of medications, mean ± SD	4.57 ± 3.44	5.85 ± 3.80‡	5.73 ± 3.93‡
Surgery area			
Intestinal	94 (37.8)	48 (5.8.)‡	33 (67.3)‡
Appendix	29 (11.6)	6 (8.2)‡	3 (6.1)‡
Gallbladder	63 (25.3)	12 (16.4)‡	8 (16.3)‡
Hernia repair	40 (16.1)	3 (4.1)‡	2 (4.1)‡
Other	23 (9.2)	4 (5.5)‡	3 (6.1)‡
Time in operating room, min, mean ± SD	106 ± 55	127 ± 61‡	126 ± 65‡
Intensive care unit admission	21 (8.4)	22 (30.1)‡	14 (28.6)‡
Foley catheter use	153 (61.4)	64 (87.7)‡	44 (89.8)‡
Length of stay, d, median (interquartile range)	7 (4–11)	16 (9–29)‡	16 (10–29)‡

SD = standard deviation.
*Except where noted otherwise.
†Acute confusional state for 48 hours or more.
‡$p < 0.05$ compared to no delirium.

were seen in populations with elevated leukocyte count and C-reactive protein level at admission.[11,18]

Interestingly, our univariate analysis suggested an association between the overall duration of surgery and postoperative delirium, although this did not reach statistical significance ($p = 0.9$). There was also no evidence that the type of surgical approach (open v. laparoscopic) had an effect on the development of delirium ($p > 0.05$). Finally, we did not find an association between the type of surgery or operating time and postoperative delirium ($p > 0.2$).

A well-established modifiable risk factor for delirium is catheter use in both the surgical and nonsurgical population.[11,13,32] Consistent with our findings, a pooled analysis showed that urinary catheterization was among the most common risk factors associated with the development of delirium, with an OR of 3.16.[33] This

Table 2: Multivariable logistic regression analysis for overall delirium and longer delirium episodes

Variable	OR (95% CI)	
	Overall delirium	Longer delirium episodes
Appendix surgery	5.26 (1.40–19.75)	—
Intestinal surgery	4.74 (1.86–12.08)	—
Mild to moderate frailty	4.50 (1.76–11.50)	7.77 (2.18–27.65)
Gallbladder surgery	4.48 (1.41–14.17)	—
Foley catheter use	3.37 91.36–8.35)	4.48 (1.76–11.50)
Intensive care unit admission	1.37 (1.06–1.78)	—

CI = confidence interval; OR = odds ratio.

emphasizes that early removal of catheters and lines should be the goal in this high-risk population.

Admission to the ICU is an established risk factor for delirium in the nonsurgical population and has been associated with delirium in the surgical population.[13,18] A recent systematic review of patients undergoing vascular surgery also showed that ICU admission was a strong independent risk factor for postoperative delirium.[34]

There is limited literature assessing the ability of the Clinical Frailty Scale to predict specific clinical outcomes such as delirium.[35] However, the scale does take into consideration, both directly and indirectly, components that have been established as independent risk factors for delirium, including functional status, comorbid disease burden and cognitive impairment.[6,36] Baseline cognitive impairment has been identified as a significant risk factor for delirium in several studies evaluating general surgery populations.[6,11,18] As such, it seems apparent that frailty assessment at admission could help identify patients at risk for delirium. Despite the consequences of frailty, there is a lack of knowledge of frailty among health care professionals, and, as a consequence, frailty assessments are not frequently used in patient care and prevention.[37]

Although the identified risk factors of ICU admission, frailty status and surgery type are nonmodifiable, early identification of these patients can allow for potential targeted interventions to reduce the incidence and impact of delirium. Proactive interventions to target patients with nonmodifiable risk factors could include comprehensive geriatric assessment and early geriatrician consultation in surgical settings.[38] This has been examined in trauma and elective surgery populations, with improved outcomes, including decreased delirium rates.[38] Further research in the acute care surgery population is necessary and is currently underway.[22]

The fact that 73% of our patients who experienced delirium did so within the first 48 hours postoperatively suggests a key window for targeted prevention and intervention. This trend was shown in other studies evaluating the general surgery population, with the majority of cases of delirium (up to 80%) occurring within 48–72 hours postoperatively.[6,15,18]

Conclusion

Overall, our findings show that older patients undergoing nonelective surgery are at significant risk for delirium. Patients at high risk in this population include those who are frail, have Foley catheters, are admitted to the ICU, and have surgery for appendiceal or biliary disease in addition to those requiring bowel resection. Further research is necessary around preventive and targeted interventions in these patients, especially within the first 48–72 hours of surgery.

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Affiliations: From the Department of Surgery, University of Alberta, Edmonton, Alta. (Saravana-Bawan, Warkentin, Churchill, Khadaroo); the Division of Geriatrics, Department of Medicine, University of Alberta, Edmonton, Alta. (Rucker, Carr); and the Department of Critical Care Medicine, University of Alberta, Edmonton, Alta. (Khadaroo).

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