



RESEARCH ARTICLE

Delirium in elderly postoperative patients: A prospective cohort study

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Abstract

Aim: To describe the incidence, time in days and risk factors for postoperative delirium in elderly patients.

Design: Prospective cohort study.

Methods: Patients over 65 years were daily screened with the 4A's Test and the Delirium Observation Screening Scale for postoperative delirium. A psychiatrist assessed according to the DSM-V. We performed descriptive and logistic regression analyses.

Results: From 202 patients, 7.5% ($N = 15$) had a diagnosed postoperative delirium, whereby 73.3% ($N = 11$) developed the delirium during the first 48 hr after surgery. The median duration was 1 day. Patients over 80 years suffering from heart failure with surgical drains, bladder catheter, central venous catheter had higher odds for developing a postoperative delirium. The incidence of postoperative delirium in our sample was lower compared with other surgical and ortho-geriatric populations. Despite age, several modifiable postoperative factors were associated with the occurrence of postoperative delirium.

KEYWORDS

delirium, general surgery, nursing assessment, outcome assessment health care, postoperative complications, postoperative delirium

1 | INTRODUCTION

Postoperative delirium mainly affecting the older population, often results in unfavourable patient outcomes, such as increased length of stay and clinically impairment of functional recovery (Hshieh et al., 2017). Delirium is defined as "an acute disorder of attention and cognition" (Inouye et al., 2014) and it is a common complication in hospitalized patients. As it has gained international attention in the recent years, there is evidence that 10%–30% of all hospitalized patients develop a delirium episode during hospitalization (Siddiqi et al., 2016).

1.1 | Background

In two European studies, the incidence of postoperative delirium (POD) in surgical patients >60 years of age was 13.2% (Ansaloni et al., 2010) and 16.9% (de Castro et al., 2014). The overall prevalence of POD after hip fracture was ranging from 43%–61% (Siddiqi et al., 2016). The high variability reported in previous studies might be related to the population under study (e.g. type of surgical/orthopaedic intervention) and the time point of assessment, such as in postanesthesia care units (PACU) or surgical intensive care units (Chaiwat et al., 2019).

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POD manifests as acute alterations in mental status, involving changes in cognition, attention and levels of consciousness that tend to fluctuate (Hughes et al., 2020). This syndrome occurs more frequently in the period from 24–78 hr postoperatively (Schmitt & Pajonk, 2008). Patients with delirium can present with different motoric subtypes that include hyperactive, hypoactive or mixed (Hughes et al., 2020). In the hyperactive form patients are agitated with the development of paranoid thoughts and incessant movement activity; the hypoactive form is characterized by predominantly calm-apatetic appearance with the occasional development of paranoid thoughts while a rapid change from hyper- and hypoactive form characterizes the mixed form (Schmitt & Pajonk, 2008). The aetiology of POD is usual multifactorial with predisposing and precipitating factors triggering its' development in an individual patient. Currently, the most prominent hypothesis to explain the development of delirium include neuronal ageing, neuroinflammation, neurotransmitter imbalance, neuroendocrine activation and network connectivity change (Maldonado, 2013; Wang & Shen, 2018).

Patients experiencing POD are at high risk of additional adverse outcomes. Some of the most frequently negative outcomes of POD described in the literature are increased length of stay (Aitken et al., 2017), cognitive decline (Inouye et al., 2016), decline in activities of daily living (Hshieh et al., 2017) and increased mortality (Aung Thein et al., 2020). Moreover, the economic burden of delirium for the healthcare system needs to be considered. In the USA, the total healthcare costs associated with delirium are estimated at \$38–152 billion per year (Douglas et al., 2013). Zywiell et al. (2015) reported incremental episode-of-care costs for POD of \$8,286.

Multidisciplinary programs have shown to be effective in the prevention and management of elderly patients with delirium in different settings (Chen et al., 2017; Hempenius et al., 2013; Igwe et al., 2020). As identifying patients at risk of developing POD and early recognition of delirium symptoms through screening and assessment is thereby part of delirium prevention and management, a comprehensive training of healthcare staff, such as on performing screening and assessment for POD is fundamental (Oberai et al., 2018). Despite numerous international guidelines (Aldecoa et al., 2017; National Institute for Health and Care Excellence, 2019), healthcare professionals' delirium management is still often inadequate in clinical practice. Nurses play a central role in the prevention of POD through careful observation of postoperative patients with the aim of early detection and treatment of POD. Yet the problem of non-recognition of delirium remains important (Bilotta et al., 2020), despite the fact that there are several tools available validated in different settings (De & Wand, 2015).

1.2 | Gap in the literature and study aims

There is a lack of studies investigated the prevalence of POD and its' associated risk factors in the older general surgical/orthopaedic population. Although patients undergoing hip fracture surgery, total hip arthroplasty or heart failure surgery are more likely to develop

delirium after surgery (Yang et al., 2017), little is known on the prevalence of POD in the general surgical/orthopaedic population representing the majority of hospitalized patients for elective or urgent procedures. While the scientific literature consistently describes age as a risk factor (Yang et al., 2017), other factors are closely related to specific populations. For instance, for patients undergoing spinal surgery risk factors were living in an institution, diabetes, cerebral vascular diseases, pulmonary diseases, opioid use (Zhu et al., 2020), while for patients undergoing major vascular surgery pre-existing cognitive impairment, hypertension, pre-existing depression and open aortic surgery have been reported as risk factors (Aitken et al., 2017). Moreover, POD might have negative consequences for nurses as well. Patients with POD often increase the complexity of nursing care and the workload for nurses that are already facing staffing shortages. Thus, further evidence on identifying patients at risk and preventing POD is needed for providing safe and high-quality nursing care and both, patients and nurses well-being. Therefore, with this study, we aimed to describe the incidence, time in days and risk factors for postoperative delirium in elderly patients.

2 | METHODS

2.1 | Study design

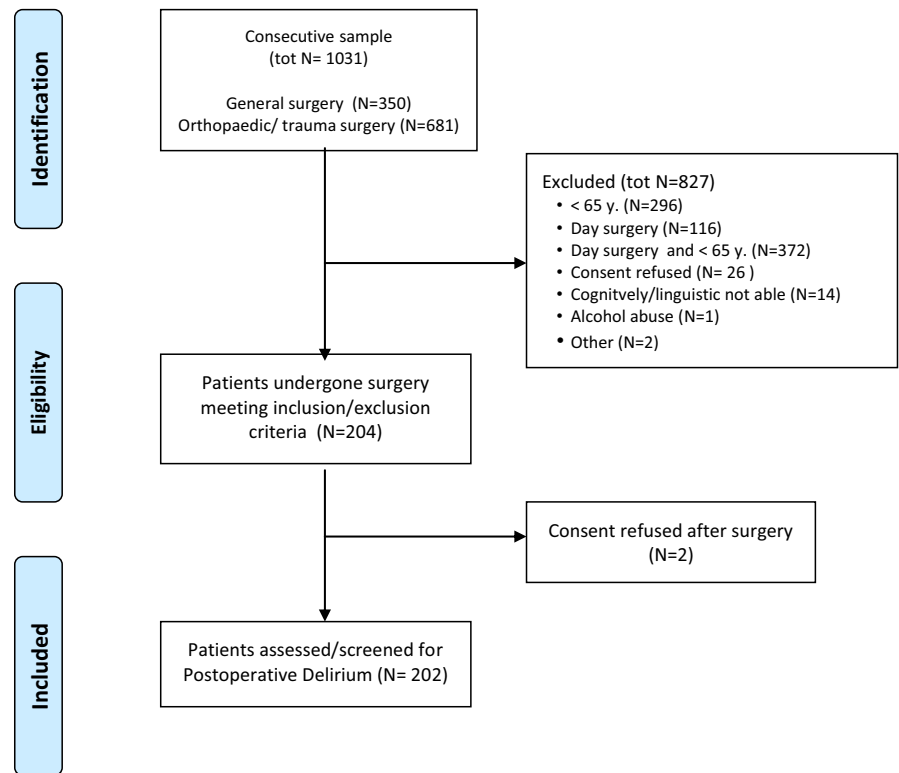
This is a prospective cohort study. Our reporting is compliant with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guideline (von Elm et al., 2007).

2.2 | Sample and setting

Two hundred and two patients admitted to two surgical and traumatic/orthopaedic wards of the hospital of Brunico-Bruneck in Northern Italy (South Tyrol) were consecutively enrolled in the study between 1st April–31st October, 2019 (see Figure 1). The hospital of Brunico-Bruneck is a district hospital and one of the seven hospitals of the South Tyrolean Health Trust (SABES-ASDAA). It has 256 acute care beds with a total number of admissions >24 hr per year of 10,542 (<https://www.asdaa.it/it/578.asp>). Patients were eligible for participation, if they (1) were 65 years or older, (2) underwent elective or urgent surgical procedures, (3) were hospitalized >24 hr, (4) sufficiently understood and talked German or Italian language. Patients who (1) were in a terminal phase and were undergoing surgery for palliative purposes, (2) had a withdrawal delirium prior to orthopaedic/surgical intervention and/or a known history of alcohol abuse, (3) were unable to give informed consent due to their level of consciousness and general condition (e.g. diagnosed dementia), or (4) had a known psychiatric history were excluded.

The sample size was calculated assuming an incidence of 15% and a 95% confidence interval (alpha error 0.05) (Charan & Biswas, 2013). This assumption was based on previous reports on

FIGURE 1 Patient flow chart



the incidence of POD in a similar patient population >60 years of age of 13.2% (Ansaloni et al., 2010) and 16.9% (de Castro et al., 2014). Out of 1,031 eligible patients, 204 (19.8%) met the inclusion criteria; two refused the consent. Thus, 202 participants were assessed for postoperative delirium.

2.3 | Variables and measures

2.3.1 | Outcome variable

The main outcome variable was POD diagnosed from appropriately trained psychiatrists according to the criteria of Diagnostic and Statistical Manual-DSM-V. POD was considered as acute alterations in mental status, involving changes in cognition, attention, and levels of consciousness that tend to fluctuate (Hughes et al., 2020) occur after a surgical or orthopaedic intervention (Schmitt & Pajonk, 2008). The presence of POD in patients participating in this study was determined daily by trained nurses who screened the patients using two valid and reliable screening instruments, that is the Delirium Observation Screening Scale (DOS) (Schuurmans et al., 2003) and the 4A's Test (4AT, www.the4AT.com) (Bellelli et al., 2014). For each patient, the 4AT and DOS score was reordered for each postoperative day. In the case of a positive POD screening, an assessment and evaluation POD was made by a psychiatrist.

The *Delirium Observation Screening Scale (DOS)* (Schuurmans et al., 2003) consists of 13 items that measure behaviours and attitudes, ability to maintain attention, verbal response, memory, emotions and perception in less than 5 min as present or absent.

A "normal behaviour" without behavioural changes is associated with a score of 0. The maximum achievable score is 13, the cut-off value is 3. Three or more points indicate delirium. In two prospective studies with high-risk patient groups, the DOS scale showed a high internal consistency (0.93–0.96) (Gavinski et al., 2016). The 4AT (Bellelli et al., 2014) is a delirium screening tool developed to provide a simple and rapid screening (generally <2 min), requiring no special training of healthcare staff. The 4AT consists of four items with a maximum achievable score of 12 points. Item 1 determines the patient's level of attention by observation. Item 2 and Item 3 assess perception and attention with the Abbreviated Mental Test-4 (AMT-4) and counting months backwards. Item 4 assesses fluctuations and acute changes in mental status. A score of 0 indicates that delirium or cognitive impairment is unlikely. A score of 4 and higher indicates delirium. The 4AT was tested in geriatric and ortho-geriatric patients demonstrating acceptable to good sensitivity (76%–87.7%) and specificity (80.0%–95.0%) (De et al., 2017; MacLulich et al., 2019). While the DOS is an observational scale, i.e., nurses simply observe the patient and his characteristics, the 4 AT is an interactive instrument, requiring an interaction between the nurses and patients. To combine the strengths of the two differing scales we used both in this study.

2.3.2 | Explanatory and control variables

Preoperative data, collected on admission, included the age, living situation, functional status, cognition, behaviour pattern, mobility, sensory deficits, number of previous admission, number of active medical problems, number of drugs were assessed with

the Blaylock Risk Assessment Screening Score-BRASS (Blaylock & Cason, 1992), *comorbidities* (assessed with the Charlson Comorbidity Index list (Charlson et al., 1987), *diagnosis at admission* (i.e., malignant abdominal tumour, fracture and rupture, prosthesis lower limbs (LL)/upper limbs (UL)), *preoperative medication* (i.e. psychotropic drugs). Perioperative data was collected for *physical status* (ASA score), *type of anaesthesia* (i.e., general or regional) and *intraoperative drugs* (opioids, benzodiazepines, ketamine), *type of surgery* (elective or urgency) and *type of analgesia* received in the Post Anaesthesia Care Unit. Postoperative data, when the patients were transferred back to the their ward, was collected on the use of *drains*, *bladder catheter*, *peripheral and/or central venous catheter*, *oxygen therapy*, *infusion*, *postoperative nausea and vomiting* recorded for the first 5 postoperative days, *pain* measured with the Numeric Rating Scale (Haefeli & Elfering, 2006): each episode with $NRS \geq 3$ was recorded from day 1 postoperatively until day 14 or until discharge. Before patients were discharged data on *unplanned admission to the Intensive Care Units (ICU)*, *surgical re-intervention*, *days from admission to surgery*, *length of hospital stay* and *in-hospital mortality* were assessed. Pre-, intra- and postoperative data was collected from the patients' health records. Telephone follow-up 30 days after discharge was conducted to assess *re-hospitalization* and *death*. Detailed information on the study variables are provided in the Table available in the [Appendix S1](#).

2.3.3 | Data collection

During the 7-months study period, the trained nurses performed a daily delirium screening (Monday - Sunday) on the orthopaedic and surgical wards for all patients meeting the inclusion criteria from the first postoperative day until the day of discharge or the 14th postoperative day. In case of a positive result of the 4AT or DOS, the responsible healthcare staff (physicians or nursing staff) was informed about the result of the screening and a trained psychiatrist was consulted for assessment and diagnosis (based on DSM-V criteria) and if considered necessary, a pharmacological therapy was prescribed. A total of 30 nurses (including a study nurse) were trained by a delirium specialist (Advanced Practice Nurse from the University hospital Bern, Switzerland) on how to perform the delirium screening using the 4AT and DOS. The study nurse informed patients about the study and enrolled them; collected all the required data at admission, peri- and postoperative data, carried out telephone follow-up and entered the data in a prepared excel sheet. Prior to the start of the study, the developed data-collection-sheet was pre-tested by a surgical nurse to check the comprehensibility of the items.

2.4 | Statistical analyses

First, a quality check was carried out on a random sample of 10% of the participants. Cross-checking the data collection sheets on

paper and the inserted data in excel, revealed accuracy of the data entry. We then used descriptive statistics (e.g. frequencies, median, interquartile range) to check for completeness and plausibility and to describe the variables under study, including the incidence of POD in our study cohort and all secondary patient outcomes. To compare characteristics between patients diagnosed with POD and those without POD, we used Chi-squared or Fisher exact test for all categorical variables. To explore the relationships between potential pre-, peri- and postoperative risk factors and POD, we performed logistic regression models. All statistical analyses were performed using the SPSS Statistics 24 software (IBM SPSS Inc, Chicago, IL). Statistical significance was set at $p < .05$.

2.5 | Ethical aspects

Permission to conduct this research project was obtained from the General Directorate and the District Directorate of the South Tyrolean Health Trust. The local ethics committee approved the study implementation by resolution 79/2018 of October 17, 2018. The confidentiality and security of the project implementation was ensured in compliance with the European Data Protection Act 2016/679 on privacy and the principles of good clinical practice. The study was conducted according to the Declaration of Helsinki regarding the Ethical Principles for Medical Research Involving Human Subjects.

Each patient was informed preoperatively (for elective procedures) or postoperatively (for urgent procedures) about the purpose and procedure of the study by the trained nursing staff and invited to participate. Data collection started after obtaining written informed consents from patients only. By signing the written informed consent form, the patients gave their consent to study participation, data collection (incl. Telephone follow-up) and analysis, as well as publication of the results. Participants could withdraw their consent to the study at any time.

3 | RESULTS

3.1 | Study sample

A total of 202 patients participated in the study, with 51.5% (104) being female. The median age was 75 years (IQR: 71–80 years). Nearly three quarter, 72.3% (146) were admitted to the orthopaedic ward, whereby 51.0% (102) received a hip and knee prosthesis (see [Table 1](#)). More details on the study sample are entailed in [Table 1](#).

3.2 | Screening and assessment for postoperative delirium

During the study period, the study nurses performed a total of 1,398 DOS and 1,448 4AT screenings in the 202 patients. For 24

TABLE 1 Socio-demographic and pre-operative characteristics of the sample and associations with postoperative delirium

Pre-operative variables	Total Sample (N = 202)	With POD (N = 15)	Without POD (N = 187)	p	Bivariate logistic regression	OR	95% CI	p
	% (N)	% (N)	% (N)					
Gender								
Male	48.8 (98)	73.3 (11)	46.8 (87)	.05	Female	0.32	0.09–1.04	.05
Female	51.2 (103)	26.7 (4)	53.2 (99)					
Age (in years)								
65–79 years	73.5 (147)	33.3 (5)	76.8 (142)	.001	Age ≥80 years	6.60	2.14–20.37	.001
≥80 years	26.5 (53)	66.7 (10)	23.2 (43)					
Reason of admission								
Prosthesis LL/UL	51.0 (102)	46.7 (7)	51.1 (95)	.50	Prosthesis LL/UL	1.19	0.41–3.42	.74
Surgery for malignant tumour –abdominal	13.4 (27)	26.7 (4)	12.4 (23)		Surgery for malignant tumour –abdominal	0.39	0.11–1.32	.13
Other surgery- abdominal	10.4 (21)	13.3 (2)	10.2 (19)		Other surgery- abdominal	0.74	0.15–3.52	.70
Fracture and rupture	12.9 (26)	13.3 (2)	12.9 (24)		Fracture and rupture	0.96	0.20–4.53	.96
Other ^a	12.4 (25)	0	13.5 (25)	Other ^a				
Ward of admission								
Trauma surgery/ orthopedy	72.3 (146)	60.0 (9)	73.1 (137)	.27	Trauma surgery/ orthopedy	0.55	0.18–1.62	.28
General surgery	27.7 (56)	40.0 (6)	26.9 (50)		General surgery			
BRASS score								
≤10	88.5 (177)	80.0 (12)	89.2 (165)	.29	BRASS score ≥11	2.06	0.53–7.93	.29
≥11	11.5 (23)	20.0 (3)	10.8 (20)					
Functional status								
Indipendent in ADL and IADL	72.6 (146)	60.0 (9)	73.7 (137)	.24	Dependant in one or more ADL/IADL	1.86	0.63–5.50	.26
Dependant in one or more ADL/IADL	27.4 (55)	40.0 (6)	26.3 (49)					
Mobility								
Ambulatory	66.8 (135)	46.7 (7)	68.8 (128)	.22	Ambulatory with mechanical	2.67	0.88–8.00	.08
Ambulatory with mechanical	27.7 (55)	46.7 (7)	25.8 (48)					
Sensory deficits								
None	56.2 (113)	53.3 (8)	56.5 (105)	.81	Sensory deficits	1.13	0.39–3.25	.81
Visual or hearing deficits	36.8 (74)	46.7 (7)	36.0 (67)					
Number active medical problems								
More than three medical problems	37.9 (85)	60.0 (9)	42.2 (76)	.12				
Number of drugs								
Fewer than 3	40.1 (81)	26.7 (4)	41.4 (77)	.07	3–5 drugs	1.10	0.26–4.56	.89
3–5	36.8 (74)	26.7 (4)	37.6 (70)					
More than 5	22.8 (46)	46.7 (7)	21.0 (39)					
Psychotropic drugs	26.2 (52)	40.0 (6)	27.4 (46)	.22	Psychotropic drugs	2.03	0.68–6.00	.20

(Continues)

TABLE 1 (Continued)

Pre-operative variables	Total Sample (N = 202)	With POD (N = 15)	Without POD (N = 187)	p	Bivariate logistic regression	OR	95% CI	p
	% (N)	% (N)	% (N)					
Comorbidity								
0 disease	21.4 (43)	6.7 (1)	22.6 (42)					
1-2 disease	58.7 (118)	53.3 (8)	59.1 (110)		1-2 disease	3.05	0.37-25.17	.29
≥3 disease	19.9 (40)	40.0 (6)	18.3 (34)	.08	≥3 disease	7.41	0.85-64.57	.07
Arterial hypertension	57.7 (115)	66.7 (10)	56.8 (105)	.59	Arterial hypertension	1.52	0.50-4.63	.46
Heart failure	33.3 (67)	60.0 (9)	31.4 (58)	.02	Heart failure	3.28	1.11-9.65	.03
Tumour	15.9 (32)	26.7 (4)	15.1 (28)	.26	Tumour	2.04	0.60-6.85	.25

Abbreviations: ADL, Activities of Daily Living; BRASS, Blaylock Risk Assessment Screening Score; Fi, Fisher; IADL, Instrumental Activities of Daily Living; Pe, Pearson; Prosthesis LL/UL, Lower Limbs/Upper Limbs.

^aSurgery in non abdominal district and other orthopaedic surgeries.

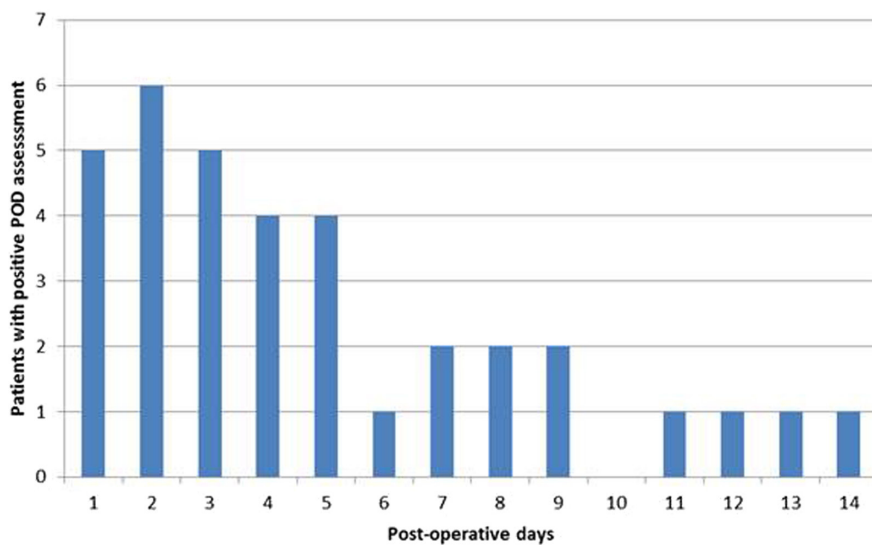


FIGURE 2 Number of positive assessments by postoperative days in patients diagnosed with POD (N = 15)

patients, the screening resulted positive for delirium symptoms with a total of 44 episodes. In 27 episodes, the subtype of delirium was defined from the study nurses as hyperactive (N = 19), hypoactive (N = 7) and mixed (N = 1). For each patient with a positive screening, the psychiatrist was contacted, who visited the patient within 24 hr. Because five patients were discharged/transferred before the visit, only 19 patients were assessed by the psychiatrist according to DSM5-criteria. In total, 15 patients were diagnosed with POD equally to a cumulative incidence of (7.5%). For 12 out of these 15 patients, a medication (benzodiazepine and/or antipsychotics) was prescribed. As described in Figure 2, for those 15 patients with a diagnosed POD diagnosis, 33% (N = 5) developed the delirium on the first postoperative day. The median duration of the POD was 1 day (IQR: 1.0-4.0). The highest incidence of POD was found on the second postoperative day (6 cases); of these, 5 out of 6 showed delirium for at least two consecutive days.

3.3 | Comparison between patients with and without POD and risk factors

As described in Table 1, patients diagnosed with delirium were predominantly male and older than non-delirious patients (p < .05). Although statistically not significant, we observed that compared to patients without delirium, those with POD had a higher Blaylock Risk Assessment Screening Score BRASS median score (8.0, IQR: 6-10 vs 6.0, IQR 4-8); were more dependent in at least one Activities of Daily Living ADL/Instrumental ADL (40.0% vs. 26.3%), had more walking problems (46.7% vs. 25.8%) and more visual or hearing deficits (46.7% vs 36.0%). The median for the Charlson Index Score was higher for patents with POD (Median: 2; IQR: 1-3 vs. 1; IRQ 1-2; p > .05). A higher percentage of patients with POD suffered from arterial hypertension (66.7% vs. 56.8%, p > .05), hearth failure (60% vs. 31.4%, p > .05) and tumour (26.7% 15.1%, p > .05).

During the postoperative course, patients with POD had more frequently a drainage (80% vs 51.1%; $p = .042$), a bladder catheter (66.7% vs 30.6%; $p = .008$), a central venous catheter or peripherally inserted central venous catheter (40.0% vs 13.4%; $p = .010$) and requiring oxygen-therapy and other devices such as nasogastric tube, epidural catheter (93.3% vs 61.8%; $p = .039$) (see [Table 2](#)).

The logistic regression analyses revealed a statistically significant association between POD and higher age (OR: 6.60; 95% CI: 2.14–20.37, $p = .001$) and hearth failure (OR: 3.28; 95% CI: 1.11–9.65, $p = .031$). In the postoperative course, patients with surgical drains (OR: 3.83; 95% CI: 1.04–14.02, $p = .042$), a bladder catheter (OR: 4.52; 95% CI: 1.48–13.84, $p = .008$), central venous catheter (OR: 4.29; 95% CI: 1.40–13.10, $p = .010$) and other devices (OR 8.64; CI 1.11–67.15 $p = .039$) were more likely to develop POD than patients without.

3.4 | Secondary patient outcomes

The median hospital stay for patients without POD was 9 days (IQR: 6–12) and postoperative stay 7 (IQR: 5–10), while for patients with POD they were 13 (IQR: 10–16) and 11 (IQR: 8–15), respectively. In the group with POD, the protected discharge was more frequent (33.3% vs. 7.1%) as well as discharge to other institutions (46.7% vs. 32.6%). In most of these patients, the reason for entry was LL/UL prosthesis. At the follow-up, 5 patients underwent an unscheduled hospital readmission, of those one was of the POD group. None of the patients died within 30 days after hospital discharge.

4 | DISCUSSION

With this study, we aimed to describe the incidence and duration of POD in general surgical and orthopaedic/traumatological patients and to explore the relationship between POD and potential risk factors. The incidence of POD detected in this study was 7.5%, and therefore lower than reported in the literature, as in similar samples of people aged over 60 years it was 15% (Ansaloni et al., 2010; de Castro et al., 2014). POD was associated with patients' age >80 years and the presence of post-surgical devices (i.e., drains, bladder catheter, central venous catheter).

As known from the literature, higher incidence of POD is associated with urgent surgery (Ansaloni et al., 2010; Saravana-Bawan et al., 2019), whereby in this study, the majority (86.6%) of the sample underwent elective surgery. Compared to previous studies in which the incidence of POD was analysed after elective surgery, the detected incidence of 7.5% in our study is closely to that reported from Ansaloni et al. (2010) for elective surgery only (6.7%). No patients died during the hospitalization and none at the follow-up. The literature suggests that ortho-geriatric patients with POD have increased risk of mortality, yet mortality was mainly investigated in patient who underwent hip surgery (Mosk et al., 2017). The results from a recent meta-analysis (Aung Thein et al., 2020) suggest that the odds for mortality in patients with POD differ by setting, with

the highest mortality on ICUs. The positive finding in our study that no patient died might be related to the fact that only 2 patients with delirium had to be admitted to the ICU.

Most episodes of POD were registered on the first or second postoperative day, which is in line with previous studies (Chaiwat et al., 2019; Saravana-Bawan et al., 2019) describing a higher risk of developing POD during the first 72 hr after surgery. The median POD duration identified in this study was 1 day, which is in line with results from geriatric ortho-geriatric populations (Ma et al., 2021). Yet, in very specific cohorts, such as cardiac-surgery patients, the mean POD duration was 2.5 days (Koster et al., 2009). Of 15 patients with POD, six (40%) had a duration that was longer or equal to 2 days. The National Institute for Health and Care Excellence guidance on Delirium (National Institute for Health and Care Excellence, 2019) emphasizes the importance of screening patients at risk for POD, but does not specify when to start and for how long. Moreover, there is a lack of recommendation when and how often to carry out the assessment during the day. The European POD guideline (Aldecoa et al., 2017) recommends assessing patients for POD for up to five postoperative days. The results of a recent survey (Bilotta et al., 2020) suggested that only a quarter of respondents investigated POD up to the third postoperative day. Some authors suggest screening at least in the first 6 postoperative days, especially to intercept POD in the hypoactive form (Ansaloni et al., 2010). Based on our finding, the onset of POD in general surgical and orthopedically patients should be closely monitored at least in the first 48–72 hr after surgery.

Of 27 POD episodes, 19 were assessed/diagnosed as hyperactive subtype and seven as hypoactive subtype. It seems that the detection of the hyperactive subtype is easier compared with hypoactive (Emme, 2020; Yang et al., 2009). Non-cooperation and aggressiveness of patients with hyperactive delirium often leads to unpredictable situations and increased complexity (Lim et al., 2022). Yet, patients with hypoactive delirium have worse outcomes than those with hyperactive delirium (Hughes et al., 2021; van Velthuisen et al., 2018), but from organizational side their management is less challenging and complex, because these patients are “quite” and perceived as cooperative (van Velthuisen et al., 2018). The use of tools and conducting structured assessments is important to identify patient with hypoactive delirium, yet it is still unclear how best to manage these patient. For instance, patients with hypoactive delirium receive less medication for treatment as those with hyperactive (van Velthuisen et al., 2018) and the NICE recommends using antipsychotic drugs with caution.

The current study revealed that adults aged 80 years or older undergoing surgery were more likely to develop POD. At preoperative baseline, these individuals had a reduced physical capacity (higher ADL dependency), higher Charlson Index and suffered more often from heart failure. Similar, previous studies conducted with older adults undergoing surgery for hip fracture (Mosk et al., 2017) found an association between POD and preoperative functional dependency. Multidisciplinary intervention, often involving non-pharmacological components (i.e. screening for POD, geriatric consultation, nurse-led POD prevention strategies) revealed to be effective in reducing the incidence and prevalence of POD (Chen et al., 2017; Igwe et al., 2020; Jin et al., 2020). The

TABLE 2 Intra- and postoperative characteristics of the patient sample and associations with postoperative delirium

Variables	Total sample (N = 202)		With POD (N = 15)		Without POD (N = 187)		p	Bivariate regression	OR	95% CI	p
	% (N)		% (N)		% (N)						
Intraoperative											
Median time pre-surgery (in hours)											
<24.5 hr	49.8 (100)		53.3 (8)		49.5 (92)						
≥24.5 hr	50.2 (101)		46.7 (7)		50.5 (94)		.80				
Urgency of surgery											
Elective	86.6 (174)		73.3 (11)		87.6 (163)						
Urgent	13.4 (27)		26.7 (4)		12.4 (23)		.12	Urgent	2.57	0.75–8.77	.13
Type of surgery											
Laparoscopy	14.5 (29)		6.7 (1)		15.1 (28)						.38
Laparotomy	85.5 (171)		93.3 (14)		84.9 (157)		.70	Laparotomy	2.49	0.31–19.75	
ASA classification											
I–II	80.0 (160)		60.0 (9)		81.6 (151)						.05
III–IV	20.0 (40)		40.0 (6)		18.4 (34)		.84	ASA III–IV	2.96	0.98–8.87	
General anaesthesia											
Yes	51.2 (103)		53.3 (8)		51.1 (95)						.38
No	48.8 (98)		46.7 (7)		48.9 (91)		.26	General (vs other)	3.14	0.86–1.09	
Intraoperative drugs											
Opioids	95.9 (186)		93.3 (14)		96.1 (172)		.48	Opioids	0.56	0.06–4.96	.61
Benzodiazepines	11.9 (23)		20.0 (3)		11.2 (20)		.39	Benzodiazepines	1.98	0.51–7.65	.31
Ketamina	100 (194)		100 (15)		100 (179)		–				
Post anaesthesia care unit drugs											
Opioids	38.3 (69)		50.0 (6)		37.5 (63)		.54	Opioids	1.66	0.51–5.39	.39
Benzodiazepinas	0.6 (1)		0		0.6 (1)		1.00				
Ketamina	0.5 (1)		0		0.6 (1)		1.00				
Postoperative											
Surgical drains											
Yes	53.2 (107)		80.0 (12)		51.1 (95)			Surgical drain-s	3.83	1.04–14.02	.04
No	46.8 (94)		20.0 (3)		48.9 (91)		.031	Pe			

TABLE 2 (Continued)

Variables	Total sample (N = 202)		With POD (N = 15)		Without POD (N = 187)		p	Bivariate regression	OR	95% CI	p
	% (N)	(N)	% (N)	(N)	% (N)	(N)					
Bladder catheter											
Yes	33.3 (67)	66.7 (10)	30.6 (57)					Bladder catheter	4.52	1.48–13.84	.008
No	66.7 (134)	33.3 (5)	69.4 (129)			.004 P					
Peripheral venous catheter											
Yes	97.5 (196)	93.3 (14)	97.8 (182)								
No	2.5 (5)	6.7 (1)	2.2 (4)			.32					
Central venous catheter or PICC											
Yes	15.4 (31)	40.0 (6)	13.4 (25)					Central venous catheter or PICC	4.29	1.40–13.10	.01
No	84.6 (170)	60.0 (9)	86.6 (161)			.015 Fi					
Other devices ^a											
Yes	64.2 (129)	93.3 (14)	61.8 (115)					Other devices ^a	8.64	1.11–67.15	.03
No	35.8 (72)	6.7 (1)	38.2 (71)			.014 Pe					
Unplanned intensive care unit- admission											
Yes	8.0 (16)	13.3 (2)	7.5 (14)								
No	92.0 (185)	86.7 (13)	92.5 (172)			.25					
Postoperative pain											
Yes ^b	69.8 (139)	85.7 (12)	68.6 (127)					Postoperative pain	2.74	0.59–12.63	.19
No	30.2 (60)	14.3 (2)	31.4 (58)			.23					
PONV											
Yes	10.1 (20)	6.7 (1)	10.3 (19)								
No	89.9 (179)	93.3 (14)	89.7 (165)			1.00					
Blood transfusion											
Yes	14.1 (28)	26.7 (4)	13.0 (24)								
No	85.9 (171)	73.3 (11)	87.0 (160)			.23					

Abbreviations: Fi, Fisher; Pe, Pearson; PONV, Postoperative Nausea and Vomiting.

^aOxygen therapy device, nasogastric tube, peridural catheter.^bEpisode NRS ≥ 3 .

implementation of checklists and tools for detecting delirium and its risk factors already in the preoperative phase offers the advantage of collecting information (e.g. cognitive status) at baseline (Jin et al., 2020). Nurses are crucial as they are the healthcare professionals who spend the most time at the patient's bedside, have access to the clinical data and have the expertise to assess patients for delirium and its risk factors.

It is important to implement such programs, which are also perceived positively by patients and their care givers, by starting as early as possible in the preoperative phase. Moreover, the involvement of family/care givers has a positive impact on clinical outcomes and family satisfaction (Qin et al., 2022). Prior to our study start, nurses were educated and trained on delirium and the use of the assessment instruments. This is a crucial aspect because the recognition of delirium is conveyed by the knowledge (Lim et al., 2022). There is a need to invest in properly trained nurses, already during university education, the implementation of assessment tools and multidisciplinary programs to manage and prevent delirium. Moreover, raising the awareness in patient caregivers on the subject of delirium can help healthcare professionals, who would find valuable allies in the caregivers.

Beside age, most of the explanatory factors associated with POD in our study sample referred to postoperative characteristics. For instance, the presence of surgical drains, bladder catheters, central venous catheters and other devices/lines were associated with POD. Similar, recent studies described that the presence of bladder catheter (Bo et al., 2019) and CVC (Negro et al., 2021) were associated with the occurrence of POD. The presence of several devices/lines such as surgical drains, bladder catheter, central venous catheter, nasal cannula for oxygen therapy may lead to patients experiencing movement limitation, as well as postponed mobilization leading to perceptual disturbances. Morandi et al. (2017) offered two possible explanations for this finding. The association of intravenous lines suggests that the POD might be associated with more severe medical conditions requiring a more invasive medical management, or, alternatively, intravenous lines itself trigger the onset for delirium. However, further research on this finding is needed.

4.1 | Limitations

The current study involved several limitations that should be considered. The hospital of Brunico-Bruneck is a district hospital, in which only general surgical and orthopaedic interventions, yet not neurosurgical or cardiothoracic interventions are performed. Several relevant clinical variables, such as blood parameters before and after surgical intervention (e.g.: haemoglobin and albumin) were not assessed, as we did not have access to this data. From a pharmacological point none of the study participants received dexmedetomidine for sedation, which might have decreased the occurrence of POD. Although patient diagnosed with dementia were excluded from the study, patients with potential cognitive impairments yet able to provide informed consent were included.

4.2 | Conclusions

This cohort study revealed an incidence of POD equal to 7.5% in general surgical and orthopaedic/traumatological patients, with most episodes on the first or second postoperative day for a duration of 24–48hr. The results of this study revealed association between POD and age ≥ 80 years and postoperative factors such as the presence of lines and devices. Despite the low incidence of POD, results of this study underline the importance of applying a POD screening and assessment in this population to early detect patients with POD, especially with hypoactive subtype.

4.3 | Relevance to clinical practice

POD is a negative outcome for patients and leads to increased complexity and workload for nurses. The findings of the present study support the importance of having trained nurses to identify surgical and orthopedically patients with POD. The use of validated and brief screening tools by nurses in clinical practice and the interprofessional collaboration make it possible to intercept the onset of delirium in its initial phases. As the recognition of POD is conveyed by knowledge, more efforts are needed to educate nurses in the bachelor' programs on this topic and the available screening and assessment tools, as well as the management of patients with POD. Further multicentric studies should investigate whether postoperative factors (such as devices) are triggers for the onset of POD.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

AUTHOR CONTRIBUTIONS

CM, FM, MKH, KT, SN, AK, DA: Made substantial contributions to conception and design, or acquisition of data, or analysis and interpretation of data. CM, FM, MKH, KT, SN, AK, DA: Involved in drafting the manuscript or revising it critically for important intellectual content. CM, FM, MKH, KT, SN, AK, DA: Given final approval of the version to be published. Each author should have participated sufficiently in the work to take public responsibility for appropriate portions of the content. All authors agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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DATA AVAILABILITY STATEMENT

Data available on request from the authors

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