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Prospective insights into spinal surgery outcomes and adverse events: A comparative study between patients 65–79 years vs. ≥80 years from a German tertiary center

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ABSTRACT

Introduction: In light of an aging global population, understanding adverse events (AEs) in surgeries for older adults is crucial for optimal outcomes and patient safety.

Research question: Our study compares surgical outcomes and AEs in patients aged 65–79 with those aged ≥80, focusing on clinical outcomes, morbidity and mortality rates, and age-related risk factors for AEs.

Material and methods: Our study, from January 2019 to December 2022, involved patients aged 65–79 and ≥ 80 undergoing spinal surgery. Each patient was evaluated for AEs post-discharge, defined as negative clinical outcomes within 30 days post-surgery. Patients were categorized based on primary spinal diagnoses: degenerative, oncological, traumatic, and infectious.

Results: We enrolled 546 patients aged 65–79 and 184 octogenarians. Degenerative diseases were most common in both groups, with higher infection and tumor rates in the younger cohort. Octogenarians had a higher Charlson Comorbidity Index and longer ICU/hospital stays. Surgery-related AE rates were 8.1% for 65-79-year-olds and 15.8% for octogenarians, with mortality around 2% in both groups.

Discussion and conclusion: Our prospective analysis shows octogenarians are more susceptible to surgical AEs, linked to greater health complexities. Despite higher AEs in older patients, low mortality rates across both age groups highlight the safety of spinal surgery. Tracking AEs is crucial for patient communication and impacts healthcare accreditation and funding.

1. Introduction

In the contemporary global landscape, there is a marked trend toward an aging population. Nations with more than 20% of their population aged 65 and older are on the rise, mirroring profound demographic changes (Ageing and health, 2022; Demographic trends, 2022). With this change, there's been a notable surge in spine surgeries among the elderly, predominantly aimed at enhancing their quality of life (Kobayashi et al., 2017, 2018; Lenga et al., 2023a). However, treating older patients remains a significant challenge. Despite recent advancements in spinal surgery, these individuals present higher risks due to their health histories and are more susceptible to adverse events (Lenga et al., 2023a; Ayling et al., 2021; Lovi et al., 2021; Meyer et al., 2022).

Our recent analysis revealed an 8.7% prevalence of adverse events within 30 days post spinal surgery in a cohort of over 1770 patients. Although this percentage seems relatively low, our dataset did not specifically detail outcomes in the older demographic (Lenga et al., 2023a). Past studies, primarily based on administrative data or smaller retrospective series focused on degenerative diseases, reported adverse event rates post spine surgery ranging from 3% to 29%. While these figures offer insights for medical decision-making, the wide range presents challenges in tailoring individual treatment plans (Kobayashi et al., 2018; Carreon et al., 2003; Imagama et al., 2011). Moreover, with the pronounced demographic shift and the surge in surgeries among octogenarians, it becomes crucial to differentiate outcomes between the "old" (65–79 years) and the "very old" (80+ years). These distinct age brackets might have significantly different risk profiles, necessitating different surgical approaches.

Emphasizing this, there's a pressing need not only for comprehensive

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morbidity and mortality conferences (MMC) to predict or counter recurring complications (Kashiwazaki et al., 2020) but also for consistent and rigorous documentation of adverse events to elevate the standard of patient care in hospitals. Alarmingly, a data deficit persists in analyzing adverse events in the elderly post spinal surgeries across varying pathologies, making the rapid development of such evaluative mechanisms indispensable.

To bridge this knowledge gap, our study group has initiated a project: a prospectively compiled database from a leading neurological tertiary center, focusing on spinal interventions. We aim to compare outcomes between patients aged 65–79 and octogenarians, seeking to elucidate their clinical paths, morbidity and mortality rates, and pinpoint risk factors for adverse events, especially those influenced by age differences.

2. Methods

In our investigation, we performed a comprehensive investigation utilizing prospective data collected from a leading neurosurgical tertiary care institution. This study, fully sanctioned by our institution's ethics committee (reference S-425/2022), conformed to the stringent ethical guidelines encapsulated by the Declaration of Helsinki. Given our context, where the completion of POPAE forms aligns seamlessly with standard institutional procedures, there was no imperative for individual informed consents. We meticulously followed data gathering and examination methodologies, congruent with our previous disclosures (Lenga et al., 2023a; Dao Trong et al., 2023). This strategy encompassed an intricate juxtaposition of our anticipatory Post-Operative Adverse Event (POPAE) database against a broader spectrum of hospital administrative records. Additionally, our tri-monthly evaluations function as a corrective apparatus, identifying and amending any numerical anomalies, thus enhancing our dataset's integrity. As previously emphasized, our repository is continually curated and augmented by a consortium of 15 credentialed neurosurgeons and 18 neurosurgical apprentices. Each departing patient received a POPAE dossier, meticulously inscribed by the ward's presiding clinician. Only after thorough validation by a senior authority was this data deemed suitable for inclusion in our repository. Should a patient revisit within 30 days post their initial operation, our medical squadron was swiftly alerted. Complex scenarios regularly graced the collective review of the neurosurgical brigade during MMC congregations. This analysis encompassed patients aged 65–79 years and 80 years and older, consciously sidelining pediatric participants and those below 65 years of age. Foundational benchmarks, pivotal for this study's methodology and interpretative framework, are exhaustively expounded in our previous publications (Lenga et al., 2023a; Dao Trong et al., 2023). Such foundational integrity assures unbroken application uniformity and terminological comprehension throughout our investigative endeavors.

3. Procedures

Surgical characteristics, transfusion due to blood loss, number of treated spinal levels, perioperative and postoperative complications, hospital length of stay (LOS), and intensive care unit (ICU) stay, were retrieved from the patients' electronic medical records. The age-adjusted Charlson comorbidity index was used to assess comorbidities (de Groot et al., 2003; Deyo et al., 1992). The CCI was calculated for each patient and classified as no comorbidity (CCI = 0), minimal comorbidity (CCI = 1 or 2), moderate comorbidity (CCI = 3–5), or severe comorbidity (CCI >5).

4. Statistical evaluation

Quantitative categories were articulated in numerical counts and corresponding percentages. Continuous datasets, authenticated for normal distribution via the Shapiro–Wilk test, were expressed in means ± standard deviations. To discern differences in fundamental and surgical characteristics between cohorts, we deployed univariate analyses. The binary logistic regression model was harnessed to pinpoint potential AE risk catalysts. We acknowledged a p-value <0.05 as the threshold for statistical relevance. All analytical endeavors were executed utilizing SPSS version 24.0.0.0 (IBM Corp., Armonk, NY, USA).

5. Results

5.1. Epidemiological data

Between January 2020 and December 2022, we examines two separate cohorts: one comprising 546 patients with an average age of 71.4 ± 4.1 years and the other consisting of 184 patients, averaging 83.1 ± 2.8 years, both of which underwent surgical interventions. Elective surgeries prominently featured in both categories (65–79 y: 91.1% vs. ≥80 y: 81.5%; p = 0.123). It's pertinent to note that while degenerative diseases were prevalent across both age groups, tumorous and infectious diseases manifested with a higher incidence in the 65–79 age bracket. Utilizing the age-adjusted Charlson Comorbidity Index (CCI), octogenarians displayed a markedly inferior health baseline relative to their younger counterparts (8.1 ± 2.2 vs. 4.1 ± 1.3; p < 0.001), with cardiac disorders registering as the predominant ailment. A comprehensive demographic summary is delineated in Table 1.

5.2. Surgical characteristics

As elaborated in Table 2, decompression surgery dominated the

Table 1
Baseline characteristics.

	65-79 y n = 546	≥80 y n = 184	p
Age, years (mean, SD)	71.6 (4.1)	83.1 (2.8)	**<0.001**
Sex (n, %)			0.123
Male	292 (53.5)	111 (60.3)	
Female	254 (46.5)	73 (39.7)	
Procedures			<0.081
Non-Elective	32 (5.7)	34 (18.5)	
Elective	514 (91.1)	150 (81.5)	
Spinal			**<0.001**
Degenerative	463 (84.8)	127 (69.0)	
Tumor	45 (8.2)	15 (8.2)	
Trauma	12 (2.2)	27 (14.7)	
Infection	26 (4.8)	15 (8.2)	
Comorbidities			
Age-adjusted CCI score (mean, SD)	4.1 (1.3)	8.1 (2.2)	**<0.001**
Arterial hypertension	119 (21.8)	96 (52.2)	**<0.001**
Myocardial infarction	47 (8.6)	68 (37.0)	**<0.001**
Coronary heart disease	59 (10.8)	75 (40.8)	**<0.001**
Atrial fibrillation	37 (6.8)	55 (29.9)	**<0.001**
Heart failure	22 (4.0)	40 (21.7)	**<0.001**
Peripheral vascular disease	16 (2.9)	44 (23.9)	**<0.001**
COPD	41 (7.5)	56 (30.4)	**<0.001**
Diabetes mellitus Type II	41 (7.5)	57 (31.0)	**<0.001**
Renal failure	23 (4.2)	54 (29.3)	**<0.001**
Liver disease	11 (2.0)	28 (15.2)	**<0.001**
Gastrointestinal ulcer	11 (2.0)	24 (13.0)	**<0.001**
TIA/stroke	4 (0.7)	17 (9.2)	**<0.001**
Malignancy	30 (5.5)	18 (9.8)	0.063
Dementia	6 (1.1)	28 (15.2)	**<0.001**
Alcohol abuse	8 (1.5)	21 (11.4)	**<0.001**
Localization			0.096
Cervical	106 (19.4)	27 (14.7)	
Cevicothoracic	7 (1.3)	2 (1.1)	
Thoracic	34 (6.2)	16 (8.7)	
Thoracolumbar	12 (2.2)	7 (3.8)	
Lumbar	318 (58.2)	119 (64.7)	
Lumbosacral	69 (12.6)	13 (7.1)	

SD, standard deviation.

Table 2
Peri- and postoperative surgical characteristics and clinical course across both groups undergoing surgery.

	65-79 y n = 546	≥80 y n = 184	p
Surgical approaches (n,%)			
Decompression	370 (67.8)	131 (71.2)	0.409
Instrumentation	176 (32.2)	53 (28.8)	
Ventral	62 (11.4)	10 (5.4)	0.081
Dorsal	433 (79.3)	154 (83.7)	
Concorde	44 (8.1)	19 (10.3)	
Dorsal and Side	7 (1.3)	1 (0.5)	
Number of operated levels	2.8 (1.1)	2.6 (0.8)	0.789
Intraoperative blood transfusion, n (%)	3 (0.5)	10 (18.4)	**0.005**
Surgical duration, min	190.8 (82.7)	170.7 (92.9)	0.641
No. of levels decompressed/fused	3.7 (1.1)	2.5 (0.7)	0.069
Hospital stay, days	7.3 (4.2)	8.2 (4.3)	**0.008**
ICU stay, days	0.4 (1.2)	0.5 (2.3)	**0.011**
Mortality (n, %)	2 (0.4)	5 (2.7)	0.071

Except where otherwise indicated, quantities are mean (SD).

procedural choice for both groups (65-79 y: 67.8% vs. ≥80 y: 71.2%; p = 0.409). The dorsal route surfaced as the surgical technique of choice, being employed by 79.3% and 83.7% of the two cohorts, respectively. Interestingly, a significantly greater fraction of octogenarians necessitated intraoperative transfusions (18.4% vs. 0.5%; p = 0.005). Additionally, the post-operative ICU and general hospital durations were notably extended for octogenarians. Despite these variations, mortality rates were consistent across both segments. Furthermore, surgical revision was warranted in 4.8% of patients aged between 65 and 79 years, while this percentage climbed to 12.5% for octogenarians.

5.3. Occurrence of surgery-related AEs

- Degenerative disease

The predominant AE in patients diagnosed with degenerative diseases across both groups was wound infection (65–79 years: 1.1% and ≥80 y 3.1%). Importantly, every one of these infections necessitated revision surgery. Six patients aged 65–79 years presented with postoperative bleeding, of whom 4 patients were revised. Two patients aged ≥80 y suffered from postoperative bleeding, a revision surgery was performed in both cases. Remarkably, 4 patients aged 65–79 years and two patients ≥80 y exhibited new neurological deficits. There were no fatalities recorded among these patients. Of significance, octogenarians demonstrated a heightened incidence of urinary tract infections relative to the younger cohort.

- Tumor disease

Outcomes were relatively parallel across both cohorts. Wound infections and dural leaks were frequently identified. No significant differences were observed between the groups, while wound infection and dural leaks were the most prevalent along both groups. The incidence of a second transfer to the ICU was 2.2% among patients aged 65–79 y and 6.7 % among ≥80 y, which was attributable to cardiac disease for both groups. One patient from each age groups deceased due to an acute heart failure.

- Trauma

In patients diagnosed with spinal trauma, postoperative infections were sporadically observed, with a scant few requiring revision. Impressively, there were zero instances of malpositioned implants in both categories. One patient aged between 65 and 79 years perished due to respiratory complications from a COVID-19 infection. Meanwhile, two patients, admitted to the ICU for pulmonary embolism, unfortunately did not survive.

- Infected spine

Postoperative wound infection was the most prevalent AE across both groups (65-79 y: 7.7% vs. 26.7%, p = 0.838). Each group experienced a single case of subsequent infections, with one recorded fatality among patients aged 80 years and older due to sepsis.

A comprehensive breakdown of surgery-related and non-surgery-related AEs can be found in Tables 3 and 4, respectively. Logistic regression analysis revealed that the occurrence of surgery-related AEs was only associated with age≥ 80 years and higher rates of comorbidities, while the surgical duration, surgical techniques, or the LOS did not

Table 3
Summary of surgery-related adverse events.

	65-79 y n = 546	≥80 y n = 184	p	Revision surgery 65-79 y n = 546	≥80 y n = 184	p
Wound event						
Degenerative	5 (1.1)	4 (3.1)	0.193	4 (0.9)	4 (3.1)	0.864
Tumor	1 (2.2)	2 (13.3)	0.292	1 (2.2)	1 (6.7)	0.761
Trauma	0 (0.0)	1 (3.7)	0.492	0 (0.0)	1 (3.7)	0.544
Infection	2 (7.7)	4 (26.7)	0.838	1 (7.7)	3 (20.0)	0.821
Dural leak						
Degenerative	4 (0.9)	1 (0.8)	0.934	2 (0.4)	1 (0.8)	0.587
Tumor	2 (4.4)	2 (13.3)	0.267	1 (2.2)	2 (13.3)	0.611
Trauma	0 (0.0)	1 (3.7)	0.167	0 (0.0)	1 (3.7)	0.274
Infection	0 (0.0)	1 (6.7)	0.283	0 (0.0)	1 (6.7)	0.118
Postoperative infection						
Degenerative	2 (0.4)	0 (0.0)	0.379	2 (0.4)	0 (0.0)	0.651
Tumor	0 (0.0)	1 (6.7)	0.711	0 (0.0)	0 (0.0)	–
Trauma	4 (33.3)	1 (6.7)	0.487	1 (8.3)	0 (0.0)	0.781
Infection	1 (7.7)	1 (6.7)	0.524	1 (7.7)	0 (0.0)	0.899
Malposition of implanted material						
Degenerative	3 (0.6)	1 (0.8)	0.600	3 (0.6)	1 (0.8)	0.672
Tumor	0 (0.0)	0 (0.0)	–	0 (0.0)	0 (0.0)	–
Trauma	0 (0.0)	0 (0.0)	–	0 (0.0)	0 (0.0)	–
Infection	0 (0.0)	0 (0.0)	–	0 (0.0)	0 (0.0)	–
New neurological deficits						
Degenerative	2 (0.4)	2 (1.6)	0.518	2 (0.4)	2 (1.6)	
Tumor	1 (2.2)	0 (0.0)	0.463	0 (0.0)	0 (0.0)	–
Trauma	1 (8.3)	0 (0.0)	1.000	1 (8.3)	0 (0.0)	
Infection	0 (0.0)	0 (0.0)	–	0 (0.0)	0 (0.0)	–
Rebleeding						
Degenerative	6 (1.3)	2 (1.6)	0.639	4 (0.9)	2 (1.6)	0.899
Tumor	0 (0.0)	0 (0.0)	–	0 (0.0)	0 (0.0)	–
Trauma	1 (8.3)	0 (0.0)	0.492	1 (8.3)	0 (0.0)	0.115
Infection	0 (0.0)	1 (6.7)	0.183	0 (0.0)	1 (6.7)	0.456
Surgical goal not achieved						
Degenerative	2 (0.4)	2	0.069	1 (0.2)	2 (1.6)	0.651
Tumor	0 (0.0)	0 (0.0)	–	0 (0.0)	0 (0.0)	–
Trauma	1 (8.3)	1 (6.7)	0.577	0 (0.0)	0 (0.0)	–
Infection	0 (0.0)	0 (0.0)	–	0 (0.0)	0 (0.0)	–
Others						
Degenerative	1 (0.2)	1 (6.7)	0.599	1 (0.2)	1 (0.8)	0.545
Tumor	0 (0.0)	0 (0.0)	–	0 (0.0)	0 0.0)	–
Trauma	0 (0.0)	0 (0.0)	–	0 (0.0)	0 0.0)	–
Infection	1 (7.7)	0 (0.0)	0.540	0 (0.0)	0 0.0)	–
Secondary transfer to IMC or ICU						
Degenerative	0 (0.0)	0 (0.0)	–	0 (0.0)	0 (0.0)	–
Tumor	1 (2.2)	1 (6.7)	0.117	0 (0.0)	0 (0.0)	–
Trauma	1 (8.3)	2 (7.4)	0.188	0 (0.0)	0 (0.0)	–
Infection	1 (7.7)	1 (6.7)	0.782	0 (0.0)	0 (0.0)	–
Death						
Degenerative	0 (0.0)	0 (0.0)	–	–	–	–
Tumor	1 (2.2)	1 (6.7)	0.587	–	–	–
Trauma	1 (8.3)	2 (7.4)	0.988	–	–	–
Infection	0 (0.0)	1 (6.7)	0.889	–	–	–

IMC, intermediate care unit; ICU, intensive care unit.

Table 4
Non-surgery-related adverse events by spinal pathology.

	65-79 y n = 546	≥80 y n = 184	p
Degenerative (n, %)			
Acute renal failure	4 (0.9)	2 (1.6)	0.065
Respiratory deficiency	0 (0.0)	2 (1.6)	0.111
Heart failure	4 (0.9)	1 (0.8)	0.789
Pneumonia	2 (0.4)	2 (1.6)	0.456
Pulmonary embolism	1 (0.2)	1 (0.8)	0.556
Urinary tract infection	1 (0.2)	6 (4.7)	**0.053**
Tumor (n, %)			
Acute renal failure	0 (0.0)	0 (0.0)	–
Respiratory deficiency	1 (2.2)	0 (0.0)	0.898
Heart failure	0 (0.0)	1 (6.7)	0.788
Pneumonia	1 (2.2)	1 (6.7)	0.566
Pulmonary embolism	1 (2.2)	0 (0.0)	0.111
Urinary tract infection	0 (0.0)	0 (0.0)	–
Trauma (n, %)			
Acute renal failure	2 (16.7)	2 (7.4)	0.457
Respiratory deficiency	1 (8.3)	2 (7.4)	0.322
Heart failure	0 (0.0)	2 (7.4)	0.777
Pneumonia	0 (0.0)	2 (7.4)	0.456
Pulmonary embolism	0 (0.0)	2 (7.4)	0.653
Urinary tract infection	1 (8.3)	1 (3.7)	0.811
Infection (n, %)			
Acute renal failure	4 (15.4)	1 (6.7)	0.732
Respiratory deficiency	0 (0.0)	1 (6.7)	0.211
Heart failure	0 (0.0)	0 (0.0)	–
Pneumonia	2 (7.6)	2 (13.3)	0.433
Pulmonary embolism	0 (0.0)	0 (0.0)	–
Urinary tract infection	1 (3.8)	0 (0.0)	0.231

play a significant role for its presence (Table 5). A supplementary logistic regression was undertaken to evaluate the correlation between the occurrence of AEs and both age groups and a spectrum of comorbidities. This analysis revealed that not only chronological age (OR 1.6, 95% CI 1.2–1.7), but also the presence of specific comorbidities such as cardiovascular diseases (OR 1.5, 95% CI 1.1–2.1), chronic neurological disorders (CND) (OR 1.2, 95% CI 1.0–1.7), and diabetes mellitus type II (OR 1.7, 95% CI 1.2–2.5), significantly contribute to the risk of AEs ($p < 0.05$ for all).

6. Discussion

The shifting demographics and the rise in the aging population inevitably lead to an increased frequency of spinal surgeries in older individuals. These surgeries aim to enhance both their clinical state and overall quality of life. However, their diminished baseline health reserves heighten their susceptibility to AEs. Consequently, making clinical decisions for this age group is challenging, particularly given the current dearth of comprehensive, prospective data on AEs post spinal surgery for these patients.

To our knowledge, our study is the pioneering effort to systematically analyze and document AEs using a prospective database for patients aged between 65 and 79 years and those 80 years and older undergoing spinal surgery. Our findings indicate that while degenerative diseases are predominant in both groups, patients in the 65–79 age bracket exhibit significantly higher prevalences of infections and tumor-related diseases. It's worth noting that octogenarians typically present a more fragile health profile, with an average CCI of 8.1, indicating considerable comorbidities. In contrast, the 65–79 age group displayed a relatively lower CCI of 4, indicating moderate comorbidities. No significant differences were observed in the surgical procedures or characteristics between the groups. However, octogenarians had notably extended stays in both the ICU and the general hospital wards. Importantly, the observed rate of surgery-related AEs for the 65–79 age group stood at 8.1%, while it was almost doubled for octogenarians at 15.8%. A similar pattern was discerned for non-surgical and revision-related AEs across both age groups. Encouragingly, mortality rates were comparably low for both groups, hovering around 2.0%. Most importantly, both age≥ 80 years and higher rates of comorbidities were significant predictors for the occurrence of surgery-related AEs.

Table 5
Risk factors associated with surgery related AEs.

Risk factor	OR (95% CI)	*p*-value
Age-Groups[a]	2.1 (1.1–3.7)	**0.049**
Age-adjusted CCI score	2.5 (1.2–5.8)	**0.002**
Duration of surgery	1.0 (0.9–1.1)	0.612
Number of levels decompressed	1.4 (0.8–1.7)	0.869
Surgical approach[b]	0.8 (0.4–2.2)	0.520
Hospital stay	1.1 (1.0–1.3)	0.778

CCI, Charlson Comorbidity Index; CI, confidence interval; OR, odds ratio.
[a] 65-79 y;
[b] instrumentation.

Numerous studies have documented that elderly patients undergoing spinal surgery experience notably higher prevalence of adverse events (AEs) and mortality rates compared to the general population (Kobayashi et al., 2017; Tan et al., 2019; Watanabe et al., 2019). This presents a profound challenge in determining optimal treatment strategies for this demographic and underscores the importance of preventing or minimizing the occurrence of AEs. For instance, Watanabe et al. in a retrospective study involving 270 octogenarians who underwent spinal surgery, found that this cohort displayed significant frailty. However, age, Charlson Comorbidity Index (CCI), and nutritional status were not identified as significant risk factors for AEs (Watanabe et al., 2019). In contrast, another study on octogenarians revealed that the prevalence of comorbidities was a dominant risk factor for AE occurrence, with a hazard ratio (HR) of 3.2 (Kobayashi et al., 2017). It is imperative to note that Wang et al.'s study was focused exclusively on elective surgeries for degenerative pathologies. They excluded emergency cases and those involving tumors, trauma, or infections, which inherently present greater challenges and where the preoperative status is pivotal. This might account for the contrasting findings between the two studies. Interestingly, Carreon et al. demonstrated that, specifically for lumbar instrumentation due to degenerative diseases, the risk threshold for perioperative complications seems to be 75 years and older, largely attributable to the increased prevalence of comorbidities in this age bracket (Carreon et al., 2003). A recent review and meta-analysis assessing outcomes of spinal surgery for degenerative conditions in advanced age revealed that patients over 80 years, given their elevated risk profile, are more susceptible to complications than their younger counterparts (Strayer et al., 2022). Aligned with these findings, our study also revealed that patients aged 65–79 years, with their moderate comorbidity profile, had an AE rate of 8.1%. Moreover, in conjunction with the previously cited research, we have also demonstrated that a patient's baseline profile is crucial in determining the progression of the disease, and that the risks associated with surgery should be the primary consideration in the decision-making process. Given these insights, it is paramount to maintain meticulous documentation of a patient's preoperative clinical status. Such records would not only inform and refine clinical decision-making but also furnish physicians with empirical data to discuss potential risks, addressing both patient and family concerns more effectively.

As anticipated, our patient sample predominantly exhibited degenerative pathologies. However, there was a significantly higher prevalence of infectious and tumorous diseases in patients aged 65–79 years compared to those aged 80 and above predominantly who suffered from traumatic fractures. This trend can be potentially attributed to octogenarians' decreased bone mineral density, making them susceptible to fractures from minor traumas like falls from standing or sitting positions. This observation aligns with findings from Tan et al. who, reported a 20% prevalence of trauma, with infection or tumor rates standing at a mere 4–6% solely in octogenarians (Tan et al., 2019)– a pattern consistent with our results. Regarding surgical interventions, dorsal decompressive approaches were predominant in both age groups.

Intriguingly, octogenarians required intraoperative blood transfusions significantly more often than the 65–79 age group. This could possibly be linked to their higher anticoagulant use due to prevalent cardiac conditions, necessitating the administration of antidotes both pre- and intraoperatively. Recent literature indicates an elevated bleeding risk without a corresponding rise in thromboembolic events, regardless of antidote use or bridging therapy (Douketis et al., 2015; Siegal et al., 2012). This risk may further be accentuated by the renal insufficiency often seen in octogenarians. In this study, octogenarians had a notably higher prevalence of cardiovascular diseases (e.g., atrial fibrillation, myocardial infarction, coronary artery disease) at approximately 40%, often necessitating anticoagulant use. Additionally, about 30% presented with renal failure. However, when examining AEs related to rebleeding, no significant differences were observed between the two age groups, suggesting that prompt administration and, if necessary, blood transfusion might be pivotal in averting severe complications.

Octogenarians experienced prolonged ICU and hospital stays, which can be attributed to their higher incidence of adverse events (AEs), necessitating these extended durations. Specifically, within 30 days post-surgery, surgery-related AEs were observed in 15.8% of octogenarians, with 12.5% of these patients requiring revision surgery. In contrast, patients aged 65–79 years exhibited nearly half the prevalence, at 8.1%, with 4.8% necessitating revisions. Echoing these findings, Watanabe et al. reported overall complication rates of 20%, with dural tear and screw misplacement emerging as the most common issues (Watanabe et al., 2019). In alignment with Watanabe et al.'s observations, our series also showed wound infections and dural leaks were the predominant AEs across diverse pathologies. Interestingly, only one patient experienced implant failure, a big contrast to the 4.5% reported by Watanabe's group. A possible explanation for our reduced implant failure and misplacement rate might be our utilization of CT-guided point-to-point navigation (Ishak et al., 2019). Results from our research indicate a mere 0.3% screw misplacement rate, suggesting that this navigation technique may be instrumental in minimizing such complications. The relatively lower prevalence of surgery-related AEs and revision rates in the 65-79-year-old cohort can likely be ascribed to two factors. Firstly, this age group typically presents with a more favorable baseline health status. Secondly, advancements in spinal surgery techniques and overall healthcare have improved outcomes. Supporting this notion, Imajo et al. in their analysis of 8033 patients with lumbar degenerative stenosis based on claims data, found a similar AE prevalence for this age bracket. They posited that the age threshold of 80 might be a critical determinant for increased complication rates, predominantly due to compromised baseline health reserves (Imajo et al., 2017).

Previous studies from our study group focused on octogenarians have shown that heightened comorbidity rates significantly increase the likelihood of complications and, in certain instances, mortality (Lenga et al., 2022a, 2022b, 2022c, 2022d, 2023b). This observation is consistent with a retrospective study of 47 octogenarians with diverse spinal pathologies, where comorbidity rates emerged as a critical factor for adverse events (AEs), exhibiting a prevalence of 17.0%. This study recorded a 30-day postoperative mortality rate of 2.1%, which resonates with our current study's observations. Conversely, the younger cohort displayed a markedly reduced postoperative mortality rate of 0.4%. This underscores, that octogenarians are distinctly more susceptible to both AEs and fatal outcomes. Previous studies utilizing large administrative databases have documented mortality rates in older patients undergoing spinal surgery, with figures ranging between 1.7% and 2.9% (Oichi et al., 2019; Rychen et al., 2019). These studies provide a context for our findings, indicating that our observed mortality rate falls within the expected range for such surgical interventions. Additionally, Li et al. reported a lower mortality rate of 1.4% following lumbar laminectomy in the elderly, highlighting the variability of outcomes based on the type of spinal surgery performed and the associated risk profiles (Li et al., 2008). Moreover, our rate is reflective of a comprehensive risk assessment strategy that integrates preoperative health status, the complexity of the surgical procedure, and postoperative care capabilities. Further examination of non-surgical AEs reveals that patients aged 65–79 years had a prevalence half that of octogenarians, at 4.8%. These findings emphasize the imperative for thorough patient assessment, comprehensive documentation, and systemic enhancements, especially as our healthcare system increasingly engages with this particular patient demographic.

Considering the above mentioned points we feel that the systematic documentation of adverse events (AEs) in elderly patients, especially when conducted prospectively, is of paramount significance in contemporary medical practice. The elderly demographic, given its unique set of vulnerabilities, such as increased comorbidities, frailty, and reduced physiological reserves, inherently possesses a heightened risk of AEs post-surgical interventions (Kobayashi et al., 2017; Kobayashi et al., 2017; Watanabe et al., 2019; Imajo et al., 2017; Saleh et al., 2017). Adopting a prospective approach to documenting these events or even classification systems promises not only improved data accuracy but also allows for timely clinical intervention, potentially mitigating poor outcomes (Dindo et al., 2004). Such diligent record-keeping serves as a robust framework to identify recurring patterns and pinpoint specific risk factors, enabling the formulation of more effective preventive strategies. Integral to this framework is the role of Morbidity and Mortality Conferences (MMC). These conferences have evolved into collaborative platforms, enabling healthcare professionals to critically review, analyze, and learn from AEs and other clinical complications (Kashiwazaki et al., 2020). By promoting a culture of continuous learning and fostering a sense of shared responsibility, MMCs work to maintain and elevate patient safety standards. For the elderly population, this integrated approach becomes indispensable due to their unique health challenges. In synthesizing the benefits of proactive AE documentation with the insights garnered from MMCs, healthcare systems stand poised to drive significant advancements in the quality of care accorded to elderly patients.

7. Limitations

Our study focuses on a particular age demographic: those aged 65 and older, with a granular comparison between the 65–79 age bracket and octogenarians. Historically, these age groups have garnered limited attention in medical literature, even though they present distinct clinical complexities. The novelty of our research emerges from two pivotal facets: one, our proactive approach in prospectively cataloging AEs associated with an array of spinal pathologies; and two, our endeavor to bridge the knowledge gap surrounding the surgical and postoperative challenges specific to these older age cohorts. However, certain study constraints warrant acknowledgment. The postoperative observation was confined to a 30-day window, potentially sidelining any extended-term complications, such as adjacent-level diseases post-spinal fusion. While the follow-up period in our study is limited to the first 30 days post-surgery, we acknowledge that this timeframe may not capture late-presenting complications or long-term mortality. A long term follow up might be necessary to evaluate long term outcomes. Furthermore, owing to the registry's nature, specific information regarding the precise surgical approaches is not available for extraction. Despite our rigorous data recording, the possibility of sporadic inaccuracies in case interpretation cannot be entirely negated, which might subtly skew our findings. From a methodological standpoint, incorporating a cohesive system, like the SAVE-V2 classification, could foster greater consistency in data capture and minimize observer discrepancies. Moreover, while our findings emphasize the surgical intricacies faced by those aged 65 and above, discerning the tangible impact of educational sessions in MMC meetings remains a nuanced challenge, highlighting the need for further exploration in this domain. While there is a notable difference in the size of our two cohorts, with 546 patients aged 65–79 years and 184 octogenarian patients, we have employed statistical methods to ensure that our analysis remains robust despite this variation. The sample size of the octogenarian cohort, although smaller, was adequate to achieve the objectives of the study and to provide meaningful insights into the surgical outcomes for this age group. Nevertheless, we acknowledge this difference as a characteristic of the study design, reflecting the inherent challenges in recruiting a larger population of octogenarian patients due to their relatively lower surgical rates. Future studies might benefit from a proportional representation to enhance comparative analyses.

8. Conclusions

Leveraging a prospective database to evaluate spinal surgery outcomes in patients aged 65–79 and those aged 80 and above, it becomes evident that octogenarians are more susceptible to surgical AEs, largely attributed to their compromised baseline health. Despite these challenges, the similarity in low mortality rates across both age groups underscores the safety of contemporary spinal surgical interventions. Comprehensive prospective documentation of AEs in spine surgery not only facilitates informed patient discussions but also serves as a pivotal foundation for refining accreditation standards and reimbursement frameworks in forthcoming healthcare reforms.

Consent to participate

The requirement for informed consent was waived because of the retrospective nature of this study.

Consent for publication

No individual person's data were included in this study.

Data material availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Code availability

The code supporting the findings of this study is available from the corresponding author upon reasonable request.

Ethics approval

The study received approval from the ethics committee of our institution (reference S-425/2022).

Authors' contributions

All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by Basem Ishak, Pavlina Lenga and Philip Dao Trong. The first draft of the manuscript was written by Pavlina Lenga and VP, PDT, KK,AU,SK, BI commented on previous versions of the manuscript. All authors read and approved the final manuscript

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Declaration of competing interest

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