The Relation of Surgical Procedures And Diagnosis Groups To Unplanned Readmission In Spinal Neurosurgery. A Retrospective Single Center Study.

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Abstract

Purpose

Unplanned readmission has gained increasing interest as a quality marker for inpatient care, as it is associated with patient mortality and higher economic costs. Spinal neurosurgery is characterized by a lack of epidemiologic readmission data. The aim of this study was to identify causes and predictors for unplanned readmissions related to index diagnoses and surgical procedures.

Methods

In this study from 2015-2017, spinal neurosurgical procedures were recorded. The main reasons for an unplanned readmission in between 30 days after discharge were identified. Multivariate logarithmic regression revealed predictors of unplanned readmission.

Results

1172 patient records were examined, of which 4.27 % disclosed unplanned readmissions. Among the surgical patients the readmission rate was 4.06 % mainly due to surgical site infections, for the non-surgical patients 5.06 % due to uncontrolled pain. A night-time surgery presented as independent predictive factor.

Conclusion

In the heterogeneous group of spinal neurosurgical patients, stratification into diagnostic groups is necessary for statistical analysis. Degenerative lumbar spinal stenosis and spinal abscesses are mainly affected by unplanned readmission. The surgical procedure dorsal root ganglion stimulation is an independent predictor of unplanned re-hospitalizations, as is timing of surgery.

Introduction

Unplanned readmissions represent a quality criterion for patient care. They are associated with costs and resource consumption. The aim of health policy measures is to identify and prevent avoidable unplanned readmissions and the resulting economic burden [1].

For the neurosurgical patient, unplanned readmission means uncertainty and is associated with a reduced prognosis, e.g. in glioblastoma [2]. Patient safety increases with low readmission rates in inpatient care. Therefore, the identification of reasons and predictors of unplanned re-hospitalization has gained interest recently. Strategies in averting primarily preventable readmissions are essential. One measure to control unplanned readmissions is the transitional care program [3].

The predictors and causes for unplanned readmission are manifold, reflecting the heterogeneous patient population in neurosurgery [4,5]. Readmission rates in cranial neurosurgery have been found to be surgery- and diagnosis-dependent [6]. In the current literature, the majority of studies and predictor analyses were done in North America on patients with spinal disorders in neurosurgery [7]. However, transfer of conclusions or deduction of these recommendations to a German cohort with national differences in health care and in cultural composition of the population is not permissible [8,9]. Only few publications of German spinal neurosurgical groups on this topic exist, and up to now, no study analyses the index diagnoses and the different surgical approaches in view of the 30-day readmission.

The aim of the present study was to assess prognostic factors in spinal neurosurgical patients undergoing surgery in Germany. Secondary study objectives were to present the reasons for re-admission and to stratify into preventable and non-preventable reasons.

Methods

The internal review board of the Medical Faculty of the University Hospital Leipzig had agreed to this retrospective data analysis (167/18-ek). According to the approval of ethics committee, the patient's written consent is not required.

Assessing administrative data from January, 1st, 2015 through December, 31st, 2017, adult patients (>18 years) who had undergone neurosurgical treatment for spine disorders at the neurosurgical department were included in the monocentric, retrospective study. Patients being unplanned inpatients at the University Hospital Leipzig within 30 days after the index treatment were identified. Patient

readmissions were not followed when transferred to other hospitals. We excluded patients who were readmitted for scheduled reasons.

The first set of "index admission" diagnoses contained all spinal neurosurgical disorders, a subdivision into operative and conservative treatment was made. The patients were divided into the index diagnosis groups "degenerative", "neoplasm", "functional disorder" and "other" (abscess, arteriovenous fistula, hemangioma). The classification was made according to the ICD-10 GM (see supplementary Table S1). The surgical procedures were presented according to the OPS-list (see supplementary Table S2).

For the observation period, we reviewed the hospital charts of each readmitted patient and obtained demographic information. Patient clinical complexity level (PCCL) was defined via the effective assessment ratio of the German diagnose related groups (DRG) coding level which integrates the technical procedures and the patient's secondary diagnoses.

Three categories of readmission were defined: (1) preventable reasons (e.g. SSI, postoperative hemorrhage, nosocomial infection, postoperative pain, falls), (2) reasons despite best practice (e. g. recurrent herniation) and (3) unrelated reasons, as proposed in the literature [4].

Statistical methods

Statistical analysis was performed with IBM SPSS Statistics 25.0 software (IBM, Armonk, New York, USA). The associations between continuous variables were examined using the t-test, categorical variables employing the Fisher exact test. For more than two categories, the Kruskal Wallis test was used. Continuous variables were described using mean values, while categorical variables were described with counts and frequencies. Binary multivariate logistic regression was used to assess significant predictive factors. The threshold of metric variables was defined by the receiver operating characteristic. Factors associated with an unplanned readmission at the univariate level with a *p* value of 0.20 or lower were integrated into the model. A two-tailed *p* value < 0.05 was considered to be statistically significant.

Results

During the study period from 2015 to 2017, a total of 1172 patients were treated as inpatients in the Neurosurgical Department of the University Hospital Leipzig, of which 935 patients underwent surgery. The majority of patients belonged to the degenerative case group (879 cases, 75 %). The exact demographic data of the patients can be seen in Table 1.

Table 1. Characteristics of the total cohort.

ICU, intensive care unit; *LOS*, length of stay; *PCCL*, patient clinical complexity level.

^acomorbidity: defined as five or more side diagnoses

Of the 935 patients receiving surgery, 50 had to be unplannedly readmitted for inpatient treatment. The characteristics of the readmitted patients are illustrated in Table 2.

Table 2. Characteristics of the readmitted cohort, stratified for index diagnosis groups and treatment management.

characteristics		Number (frequency in %)/ mean
index diagnosis group	degenerative	879 (75)
	cervical stenosis	82 (7.00)
	thoracic stenosis	3 (0.26)
	lumbar stenosis	312 (26.62)
	cervical herniation	125 (10.67)
	lumbar herniation	346 (29.52)
	listhesis	11 (0.94)
	neoplasm	62 (5.29)
	unknown tumor	19 (1.62)
	meningeoma	10 (0.85)
	other benign tumor	17 (1.45)
	malignant neoplasm	6 (0.51)
	plasmocytoma	1 (0.09)
	cyst	9 (0.77)
	functional	192 (16.38)
	chronic pain	186 (15.87)
	spasticity	6 (0.51)
	other	39 (3.33)
	discitis	10 (0.85)
	abscess	2 (0.17)
	empyema	5 (0.43)
	epidural hematoma	4 (0.34)
	arteriovenous fistula	6 (0.51)
	arteriovenous malformation	4 (0.34)
	hemangioma	3 (0.26)
	spina bifida	2 (0.17)
	tethered cord	2 (0.17)
	borreliosis	1 (0.09)
age, years		57.14 (18-92)
gender, female		540 (46.08)
PCCL		1.54 (0.2-21.67)
LOS in days		6.15 (1-68)
LOS in days	1-8 days	988 (84.30)
	9-16 days	133 (11.35)
	≥17 days	51 (4.35)
mean number of side diagnoses		4.37 (0-48)

comorbidity ^a		417 (35.58)							
discharge	home	1135 (96.84)							
	rehabilitation	22 (1.88)							
	external hospital	8 (0.68)							
	at own discretion	6 (0.51)							
	death	1 (0.09)							
surgery		935 (79.78)							
surgery time, minutes		126 (19-561)							
number of patients with ICU stay		32 (2.73)							
	whole group	surgical	surgical – degenerative	surgical – neoplasm	surgical – functional	surgical – other	non-surgical	non-surgical degenerative	non-surgical functional
readmitted patients, N	50	38	27	1	9	1	12	9	3
readmission rate in %	4.27	4.06	3.82	2	5.96	3.57	5.06	5.23	7.32
Total, N	1172	935	706	50	151	28	237	172	41
age	61	63	65	59	57	59	57	56	56
gender, female	27 (54.00)	18 (47.37)	14 (51.85)	0	3 (33.33)	1 (100)	9 (75)	7 (77.78)	2 (66.67)
PCCL	2.06	1.95	1.92	2.03	1.94	3.19	2.37	2.89	0.87
LOS, days	7.04	8.37	9.48	5.00	3.89	22.00	2.83	3.22	1.67
LOS readmission, days	7.90	8.92	10.44	4.00	3.67	20.00	4.67	5.11	3.33
time between discharge and readmission, days	13.30	12.11	11.52	30.00	10.33	26.00	17.08	16.22	19.67
surgery at readmission	31 (62.00)	25 (65.79)	17 (62.96)	1 (100)	7 (77.78)	0	6 (50)	5 (55.56)	1 (33.33)
reoperation rate in %	2.65	2.67	2.41	2.00	4.64	0.00	2.53	2.91	2.44

LOS, length of stay; N, number; PCCL, patient clinical complexity level.

Unplanned readmission cohort

The overall readmission rate of the study population is 4.27 %. The majority of readmissions involved patients with degenerative spine disease (36 cases). The main reasons for unplanned readmission were SSI (17 cases), followed by pain (16 cases). The different reasons for readmission are shown in Fig. 1.

The readmission rate among the surgical cases was 4.06 % with 38 unplanned readmissions. The main reason for unplanned readmission was SSI (15 cases) followed by recurrent disc herniation (three cases) and malfunction of implanted SCS electrodes (4 cases).

Among the above readmitted 38 patients with surgery at index admission, SSI were present in 15 cases (39.5 %), resulting in an overall SSI rate of 1.6 % in surgical patients. Together with two SSI in the conservatively treated patients this sums up to a wound healing disorder rate of 1.5% (17 of 1172) in the whole cohort. SSI in the non-surgical group are due to previous surgery before initial admission. The two SSI in the non-surgical group refer to previous surgeries that occurred more than 30 days before re-hospitalization and therefore cannot be counted as index admissions in these cases.

SSI was superficial in 52.9 % (9 cases), deep wound healing disorders were present in 41.2 % (7 cases) and cerebrospinal fluid fistula occurred in 5.9 % (1 case). One patient in the 'surgical degenerative' group underwent unplanned readmission at the Department of Vascular Surgery for an infrarenal abdominal aortic aneurysm, recorded as 'unrelated readmission' category.

The readmission rate for patients treated conservatively or non-surgically was 5.06 % with twelve unplanned readmissions. Here, persistent pain (9 cases) followed by late-onset SSI (2 cases) were prominent.

Unplanned surgery was required in 31 cases; 13 SSI, 3 SCS electrodes, and 4 recurrent disc herniations needed surgical revision. Among patients initially treated conservatively, 6 cases required surgery at the time of unplanned readmission. 4 patients underwent surgery for persistent pain, 1 patient for SSI and 1 for herniated disc.

The majority of the 50 unplanned readmissions was classified as 'preventable' (35 cases, 70 %), 27 preventable cases could be assigned to the surgical group with SSI (15 cases). For the non-surgical group, we identified 8 'preventable' readmissions mainly due to uncontrolled pain.

Significantly more patients with lumbar spinal stenosis (42 % vs. 26.1 %, $p = 0.021$) were readmitted unplannedly. A detailed summary of the index diagnosis groups is shown in Table 3.

Table 3

Synopsis of index diagnosis groups comparing the readmitted and the non-readmitted population. Number, frequency and *p* value determined by Fisher exact test.

total cohort N = 1172		unreadmitted group N = 1122	readmitted group N = 50
		number (%)	number (%)
index diagnosis groups	cervical stenosis	81 (7.22)	1 (2.00)
	thoracic stenosis	3 (0.27)	0
	lumbar stenosis	293 (26.11)*	21 (42.00)*
	cervical herniation	121 (10.78)	4 (8.00)
	lumbar herniation	337 (30.04)	9 (18.00)
	listhesis	10 (0.89)	1 (2.00)
	discitis	10 (0.89)	0
	intraspinial cyst	9 (0.80)	0
	unknown tumor	19 (1.69)	0
	meningeoma	10 (0.89)	0
	other benign tumor	16 (1.42)	1 (2.00)
	malign tumor	6 (0.54)	0
	hematoma	4 (0.36)	0
	empyema	5 (0.45)	0
	abscess	1 (0.09)	1 (2.00)
	hemangioma	3 (0.27)	0
	arteriovenous malformation	4 (0.36)	0
	arteriovenous fistula	6 (0.53)	0
	tethered cord	2 (0.18)	0
	spina bifida	2 (0.18)	0
	spasticity	6 (0.53)	0
	chronic pain syndrom	172 (15.33)	12 (24.00)
	other (borreliosis. plasmocytoma)	2 (0.18)	0
N, number.			
* <i>p</i> value < 0.05			

Considering readmitted surgical patients (n = 38), significant differences in the frequency of index diagnoses were detected compared to the non-operated group (n = 12). Patients with lumbar disc herniation were significantly less likely to be readmitted (15.8 % vs. 31%, *p* = 0.048) whereas operated patients with lumbar spinal stenosis were readmitted more frequently (42.1 % vs. 24.1%, *p* = 0.019).

The unplannedly readmitted patients were treated significantly longer during index admission than the group without readmission (index admission LOS 9–16 days: 29 % vs. 13.4%, *p* = 0.014). The timing of index surgery was also different between the readmitted and unreadmitted patients. Readmitted patients had received significantly more often emergency night shift surgeries (5.3 % vs. 0.1 %, *p* = 0.005).

Operative procedures

A closer look at the different surgical procedures and an analysis regarding the unplanned readmission group vs. the non-readmitted cohort revealed only few significant differences. The surgical procedures and access routes are shown in Table 4. In particular, there were no differences between the two groups with regard to the surgical access. Regarding intraoperative procedures between the readmitted and the non-readmitted group, sequestrectomy (18.4 % vs. 34.8%, $p = 0.036$) and intervertebral cage fusion (0% vs. 10.6%, $p = 0.026$) were less frequently and placement of an electrode for dorsal root ganglion stimulation significantly more often (5.26 vs. 0.6%, $p = 0.03$) performed.

Table 4
Synopsis of surgical access and procedures comparing the readmitted and the non-readmitted population. Number, frequency and p value determined by Fisher exact test.

Total surgical group N = 935		unreadmitted group N = 897	readmitted group N = 38
		number (%)	number (%)
surgical access	subcutaneous	15 (1.67)	2 (5.26)
	intraspinal extradural	520 (57.97)	18 (47.37)
	material implantation ^a	312 (34.78)	18 (47.37)
	intraspinal intradural	32 (3.57)	0
	intraspinal intradural intramedullary	6 (0.67)	0
surgical procedure	sequestrectomy and nucleotomy	312 (34.78)*	7 (18.42)*
	spinal decompression	191 (21.29)	7 (18.42)
	intervertebral cage fusion	95 (10.59)*	0*
	spondylodesis	71 (7.92)	6 (15.79)
	spinal cord stimulation	59 (6.58)	4 (10.53)
	Generator implantation	41 (4.57)	4 (10.53)
	resection of intraspinal tumor, except for neurinoma	31 (3.46)	0
	resection of intraspinal neurinoma	14 (1.56)	2 (5.26)
	wound débridement	13 (1.45)	2 (5.26)
	medication pump implantation	12 (1.34)	0
	peripheral nerve stimulation	10 (1.11)	1 (2.63)
	resection of intraspinal empyema	10 (1.11)	1 (2.63)
	resection of intraspinal hematoma	7 (0.78)	1 (2.63)
	corporectomy	7 (0.78)	1 (2.63)
	dorsal root ganglion stimulation	5 (0.56)*	2 (5.26)*
	resection of arteriovenous malformation	5 (0.56)	0
	lumbar puncture	3 (0.33)	0
	biopsy	2 (0.22)	0
	cancel/ abort procedure	1 (0.11)	0
N, number.			
* p value < 0.05			
^a anterior cage fusion, spondylodesis, generator and/or electrode implantation			

Prognostic factors

Binary logarithmic regression analysis was used to examine prognostic factors for unplanned readmission in a multivariate analysis. Considering the entire cohort, only surgery during night-shift showed to be predictive for unplanned readmission (see Table 5).

Table 5

Predictors for unplanned readmission. Multivariate logistic regression for demographic data and hospital characteristics. Factors at the univariate level with a p value ≤ 0.20 have been integrated into the multivariate logistic regression model.

multivariate regression	OR (95% CI)	p-value
total cohort		
age, > 48 years	2.180 (0.674–7.057)	0.193
PCCL, >7	2.000 (0.870–4.595)	0.102
surgery, ≥ 2 interventions	1.776 (0.593–5.320)	0.305
night shift surgery ^a	64.482 (4.270-973.702)	0.003
comorbidity ^b	1.356 (0.646–2.848)	0.421
previous organ transplantation	12.054 (0.991-146.592)	0.051
<i>index diagnosis groups</i>		
lumbar herniation	1.672 (0.423–6.617)	0.464
cervical stenosis	1.842 (0.203–16.748)	0.588
lumbar stenosis	3.033 (0.988–9.310)	0.053
abscess	19.774 (0.980-398.907)	0.052
chronic pain	2.497 (0.761–8.197)	0.131
surgical group		
age, > 50 years	1.926 (0.664–5.590)	0.228
LOS, > 6 days	2.050 (0.880–4.775)	0.096
comorbidity ^b	1.443 (0.656–3.174)	0.361
surgeries, ≥ 2 interventions	1.521 (0.473–4.896)	0.482
diabetes mellitus	5.284 (1.152–24.241)	0.032
previous organ transplantation	16.366 (0.973-275.302)	0.052
<i>surgical access</i>		
intraspinal extradural	1.047 (0.247–4.433)	0.951
<i>surgical procedure</i>		
sequestrectomy and nucleotomy	1.061 (0.250–4.502)	0.935
spondylodesis	1.954 (0.445–8.584)	0.375
resection of intraspinal neurinoma	4.768 (0.570-39.902)	0.150
Generator implantation	3.826 (0.877–16.681)	0.074
dorsal root ganglion stimulation	11.665 (1.704–79.833)	0.012
<i>index diagnosis group</i>		
lumbar herniation	2.132 (0.367–12.402)	0.399
<i>CI, 95% confidence interval; LOS, length of stay; OR, odds ratio, PCCL, patient clinical complexity level.</i>		
^a night shift: 7 p.m. until before 7 a.m.		
^b comorbidity: defined as five or more side diagnoses		

multivariate regression	OR (95% CI)	p-value
lumbar stenosis	3.874 (1.053–14.249)	0.042
abscess	28.482 (1.369–592.582)	0.031
benign tumor	6.241 (0.402–96.794)	0.190
chronic pain	3.054 (0.749–12.456)	0.120
non-surgical group		
gender: female	5.915 (1.408–24.857)	0.015
PCCL, >1	4.404 (1.063–18.245)	0.041
<i>CI</i> , 95% confidence interval; <i>LOS</i> , length of stay; <i>OR</i> , odds ratio, <i>PCCL</i> , patient clinical complexity level.		
^a night shift: 7 p.m. until before 7 a.m.		
^b comorbidity: defined as five or more side diagnoses		

Other factors, such as index surgical procedure, LOS, age, discharge modality, or preexisting conditions reached significance only at the univariate level. (Table S3)

A closer look at the surgical group allows the identification of further predictive factors. Lumbar spinal stenosis, spinal abscess as index diagnoses and a dorsal root ganglion stimulation emerged as predictive factors. The presence of diabetes mellitus as pre-existing condition was also an independent risk factor favoring unplanned readmission in this cohort.

Regarding the non-surgical group, PCCL and female gender were independent predictors of unplanned readmission. Further stratification for index diagnosis did not reveal any independent predictive factors.

Discussion

The present study examines not only the role of different index diagnosis groups, but also the influence of surgical procedures and access routes on the frequency of unplanned readmission in between 30 days after index treatment.

Previously, a pronounced heterogeneity of spinal pathologies with associated readmission rates and causes for readmission have been published.

The study discloses an overall readmission rate of 4.27 % with discretely higher readmission rates in patients who had been treated conservatively compared to operated patients. The literature reports similar readmission rates of 4–7%, depending on the index diagnosis in spinal neurosurgery [7]. Recently, in a German collective lower readmission rates of 2 % after spinal neurosurgical procedures were found [9]. However, this study had different patient numbers across the diverse diagnostic groups. In addition, we included non-surgically treated patients in order to represent a broader spectrum of patients in spinal neurosurgery.

Readmission rates vary by index diagnosis with a readmission rate of 4.6 % for lumbar [7], 2.5% for cervical degenerative pathologies [10], 7.4 % for functional spine procedures [11] and 14.2% for spine tumors [12]. In our cohort, the readmission rate for spinal neoplasms was significantly lower.

The readmission rate for spine patients after neurosurgical treatment in the present study lies with 4.27 % much lower than the 7.4 % rate in our corresponding local patient cohort receiving cranial neurosurgical treatment [6]. This difference can partly be explained by the higher complexity of cranial surgery and the longer cranial neurosurgical intervention times as well as the higher need for inpatient treatment when complications arise [4]. Similar to cranial patients SSI was found to be most important for readmission, whereas concomitant neoplasm or insufficient social support did not pose problems [13].

The readmitted operated spine patients showed a significantly longer index LOS than the group without unplanned readmission. This is consistent with previous studies that proposed to consider LOS as an independent predictive factor for re-hospitalization [14,15].

The need for repeated surgery is one source for prolonged LOS during index treatment, similarly perioperative complications make an unplanned readmission more likely [16].

The main reasons for unplanned readmission was SSI (34% for the total collective, 39.5 % for the surgical group), which is considered to be 'preventable'. The overall SSI rate was low at 1.4 %, confirming previous publications. In other studies, SSI were also found to be a leading cause of unplanned readmission with a frequency of 24 % – 39.8 % [7,9,17–20].

Another potentially preventable reason for readmission was pain (32% of the whole readmitted group). Among surgical patients, this reason for admission was present in 18.42 % and is comparable to the literature [18]. Among the non-surgical group, a total of 75 % of readmissions were due to uncontrollable pain.

The reason for this appears to be inadequate control of symptoms by the initial conservative therapy. Especially in several patient groups with degenerative spine disease, surgical intervention is postponed until ineffectiveness of conservative therapy has been shown. This group of unplanned readmitted patients is therefore difficult to minimize. An exact indication for neurosurgical intervention has to put the individual benefit of the patient into the forefront, bearing in mind differences in treatment regimes nationally, institutionally and also interdisciplinary [21].

Considering predictors, night-time surgery was found to be significant in the entire population. Night-time surgery increases the risk of intraoperative complications [22]. However, previous studies indicated that the timing of surgery did not affect the clinical outcome of patients [23]. Interestingly, in cranial neurosurgery patient a relationship between timing of surgery and readmission rate was found, but restricted to patients with hydrocephalus [13].

In addition, we demonstrated that the index diagnosis of lumbar spinal stenosis constitutes a significant predictor mainly due to increased patient age and higher number of secondary diseases. Especially older patients after lumbar spine surgery have a higher complication and readmission rate [24]. As well, spinal abscess as an index diagnosis was shown to be a prognostic factor for unplanned readmission.

Most prominently, the surgical procedure of dorsal root ganglion stimulation was associated with a high readmission rate (7.4 %). This is mainly due to infections or complications with the device [11]. Precise patient selection thus is mandatory to avoid postoperative complications.

Contrasting to the present results, studies had shown that long-stretch lumbar fusion in particular is associated with increased readmission rates [12]. Dural tear and subsequent dural closure had been associated with an increased risk of developing postoperative complications [25]. Nevertheless, we could not substantiate a statistical association with increased unplanned readmission in this study.

Rather similar to cranial neurosurgical patients, patient-dependent factors, such as the presence of diabetes mellitus as a pre-existing condition, were associated with an increased risk of readmission [6]. Diabetes mellitus increases the risk of SSI after lumbar spine surgery [26] and results in prolonged LOS [27].

For the conservative therapy group, female gender was identified as a predictive factor for unplanned readmission. Gender was confirmed to be a risk factor for unplanned readmission in some studies [28]. In addition, we identified PCCL as a predictor, in accordance with previous studies [5,6]. PCCL represents a good measurement for the severity of the patient's secondary diseases [29] and also provides indirect information on the presence of complications during an inpatient stay, which can be taken into account preoperatively.

To minimize preventable unplanned readmission in spine surgery we suggest an appropriate patient selection and strict indication. Similarly, postoperative wound care and patient education [30] as well as sufficient pain medication can reduce unplanned re-hospitalization. Based on our results, we do not recommend night-shift surgery if the indication justifies waiting.

Limitations

The limitations of this study comprise the retrospective single center design. Only patients who were readmitted to our hospital were identified. Urgent emergencies such as thromboembolism or cardiac complications might have been admitted to hospitals elsewhere,

near the patient's home, as well as "small" wound problems, that may have been treated on an outpatient base. Additionally, there is the limitation due to the coding function of medical documentation. Correctness of documentation or missing values cannot be compensated.

Outlook

Further studies with larger cohorts are necessary to estimate the reasons for readmission and risk factors of especially rare neurosurgical clinical pictures. In the heterogeneous field of neurosurgery, a targeted identification of risk constellations to avoid complications and unplanned readmissions is possible for some patient factors such as age, diabetes mellitus or case complexity (PCCL) in connection with common diagnoses e.g. lumbar stenosis, but remains elusive for the rare entities with individual operative approaches and risks.

Conclusion

We showed a total readmission rate of 4.5% in a three-year retrospective study of 1172 spinal neurosurgical patients in a large German Neurosurgical Clinic. Unplanned readmission is most often seen in patients who underwent surgery for lumbar stenosis or spinal abscess. Dorsal root ganglion stimulation was an independent predictive factor for unplanned readmission, as well as the side diagnosis of diabetes mellitus, the patient clinical complexity level and night-time surgery. Furthermore, some predictors were partly modifiable, involving the surgeon, the anesthesiologist and the patient's generalist. The majority of readmissions were classified as preventable, with non-healing surgical wounds and uncontrolled pain being the most frequent ones.

Abbreviations

CI confidence interval

DRG German diagnose related groups, 2020

e.g. example given

ICD-10-GM Classification of Diseases and Related Health Problems, 10th Revision, German Modification

ICU intensive care unit

LOS length of stay

No. number

OR odds ratio

PCCL patient clinical complexity level

SSI surgical site infection

UTI urinary tract infection

Declarations

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Consent to participate:

Not applicable.

Consent for publication:

For this type of study formal consent is not required.

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Figures

Figure 1

Reasons for unplanned readmission according to the index diagnosis groups. N, number; SSI, surgical site infection; UTI, urinary tract infection

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