Outcome and cost of spinal fractures and spinal tumors

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Abstract The aim of the study was to delineate rates of surgery, length of hospital stay, return to work, iterative surgery rates and cost to society of spinal tumor (ST) and spinal fracture (SF) surgery in Belgium. Overall surgery rates were obtained from the National Institute for Health Care and Disability Insurance. Medical and financial claims data were abstracted from the administrative database of the Alliance of Christian Sickness Funds which includes data of 42% of the mandatory insured Belgian population. All records including the reimbursement codes for ST and SF surgery in 2005 were identified. A logistic regression model was developed to determine the socio-demographic, surgery-related and sick leave predictors of return to work. Our database contained information about 3,791 patients who underwent surgery for SF and 2,322 patients who had surgery for ST. Year-to-year surgery rate growth for SF was estimated at 15%. The yearly increase in surgery rates for ST was calculated at 11%. The return to work rate was 90% 1 year after surgery for both SF and ST. Sixty percent of patients who underwent radiotherapy and surgery for ST were still alive 1 year after surgery. Length of hospital stay ranged from 1 to 27 days after surgery for ST and from 1 to 16 days after surgery for SF. Repeat surgery was performed in 8% of the ST cases and in 12% of the SF patients. Return to work rate remained significantly lower for blue collar workers, self-employed

workers and patients with a longer sick leave before surgery. Patients who were absent from work for more than 3 months at time of surgery represent a high-risk group with regard to successful functional recovery.

Keywords Spinal fractures · Spinal tumors · Surgery rates · Return to work · Cost of surgery

Introduction

Surgery for metastatic disease of the spine remains controversial because of the variable outcome in patients with a limited lifespan. The indications for operative intervention include progressive neurological deficit before, during, or after radiation therapy, intractable pain unresponsive to conservative treatment, need for histological diagnosis, radioresistant tumors and spinal instability or vertebral collapse with or without neurological deficit. Goals of surgery include decompression of neural structures, pain relief, debulking or removal of tumor mass, and spinal stabilization to prevent deformity and to allow mobilization. Patient's poor nutritional status and immunosuppression from disease or treatments remain a surgical challenge [2, 3].

Surgery for spinal fractures (SFs) is often indicated after traumatic injury by motor vehicle, occupational and sporting accidents. The ensuing occupational, financial and emotional setbacks are a challenge for surgeons especially in this typically young patient population [1].

In this chapter, rates of surgery, length of hospital stay, return to work and iterative surgery rates of spinal tumor (ST) and SF surgery in Belgium are analyzed and discussed. The final objective was to estimate financial burden to society in terms of social security in-hospital costs.

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Methods

The study was carried out on the administrative patient record files from the largest Belgian sickness fund, covering approximately 42% of the population. Sickness insurance is legally imposed in Belgium. Patient medical records between 1996 till 2005 were reviewed and the following information abstracted: demographics, procedure codes, length of stay, social security costs, sick leave before surgery and return to work. Overall surgery rates were obtained from the National Institute for Health Care and Disability Insurance. Patient records were followed until 1 year after surgical intervention. The official nomenclature descriptions of the selected surgical procedures for spinal trauma were: bloody reposition of luxation, fracture or fracture-luxation of the cervical spine without fixation, cervical osteosynthesis with or without grafting, bloody reposition of luxation, fracture or fracture-luxation of the dorsolumbar spine without fixation and vertebral osteosynthesis. The official nomenclature descriptions of the selected surgical procedures for ST were: tumor exeresis of the posterior arch, tumor exeresis of the vertebral body, resection and reconstruction of one or more vertebral bodies.

Costs were calculated from the perspective of the social security. In-hospital costs were categorized as follows: nursing, anesthesia, imaging, kinesitherapy, orthopedics, physiotherapy, orthosis and drugs. Lodging included staff costs such as nursing, catering, hotel and general administration costs.

Logistic regression analysis was used to assess socio-demographic, procedural and sick leave characteristics associated with return to work rates.

Results

Our database contained information about 3,791 patients who underwent surgery for SF and 2,322 patients who had surgery for ST. Patients were on average 50 years old with an equal male to female incidence. Patients who underwent surgery for SF were more likely blue collar worker (SF: 57% blue collar worker, ST: 50% blue collar worker), more likely operated by a neurosurgeon (SF: 75% neurosurgeon, ST: 47% neurosurgeon), and more likely employed before surgery (SF: 19% employed, ST: 16% employed). Compared with the ST subset, patients undergoing surgery for SF had a shorter median sick leave before surgery (SF: 7 days, ST: 11 days).

Surgery rates

Surgery rates ranged from 2 interventions per 100,000 inhabitants after SF in 1995 to 10 operations per 100,000

inhabitants in 2005. Year-to-year surgery rate growth was estimated at 15%. For ST surgery, the annual rate was 3 per 100,000 inhabitants in 1995 and 6 per 100,000 inhabitants in 2005. The yearly increase in surgery rates was calculated at 11%.

Return to work

Return to work rate was 90% 1 year after surgery for both SF and ST. The 1 year return to work rate varied significantly between the occupational groups (white collar worker: 90%, blue collar worker: 85%, self-employed: 80%). Forty percent patients who had a sick leave of more than 3 months before surgery were unable to resume activity 1 year after surgery. Conversely, only 10% of patients having a sick leave less than 3 months prior to surgery did not resume work 1 year after intervention.

Length of hospital stay

Length of hospital stay ranged from 1 to 27 days after surgery for ST and from 1 to 16 days after surgery for SF. The distribution of length of stay after surgery for ST and SF is displayed in Fig. 1.

Iterative surgery rates

Overall iterative surgery rates 1 year after initial surgery were calculated at 10%. Repeat surgery was performed in 8% of the ST cases and in 12% of the SF patients.

Survival after radiotherapy and surgery for ST

Sixty percent of patients who underwent radiotherapy and surgery for ST were still alive 1 year after surgery (Fig. 2).

In-hospital costs

The majority of in-hospital costs were attributed to lodging (ST: 39%, SF: 44%). Kinesitherapy and physiotherapy account for 19 and 6%, respectively, in the ST group (SF: 17 and 8%, respectively) (Figs. 3, 4).

Risk-adjusted return to work rates

After adjusting for other covariates, there was no statistical difference for return to work rates between ST and SF. Return to work rate remained significantly lower ($P < 0.001$) for patients with a longer sick leave before surgery, regardless of whether SF or ST were present. Return to work rates were significantly lower in the subset of self-employed and blue collar workers. No difference

Fig. 1 Length of hospital stay (days) after surgery for spinal fracture and spinal tumor

Fig. 2 Survival (months) after radiotherapy and surgery for spinal tumor

was found for the patient subsets with regard to gender, age and specialty of surgeon (Table 1).

Discussion

This retrospective cohort study has several methodological strengths including a multicenter focus, a sizable cohort and an acceptable follow-up rate. A limitation of the current study is the retrospective design. It was, therefore,

impossible to provide detailed information on the type of tumor or fracture and surgery modalities.

Trend in surgery rates

The rising trend in surgical rates for ST and SFs is related to the increase in the aging of the Belgian population and the availability of noninvasive imaging modalities in the early diagnosis and treatment of SF and ST. The rising trend in surgery for SFs may be due to the rising trend in

Fig. 3 Distribution of in-hospital social security costs for surgery for spinal tumors

Fig. 4 Distribution of in-hospital social security costs for surgery for spinal fractures

traffic and the stringent speed control measures taken by the Belgian government. As a consequence, victims of traffic road accidents are more likely to survive with after spinal trauma.

Survival

Survival time is an important factor in the decision making whether to operate upon a patient with a ST. In general, a minimum life expectancy of 3–6 months has been accepted to perform surgery. Overall, 1-year survival rates in surgery for spinal metastasis vary between 0 and 83%, depending on the primary cancer tissue type. Negative prognostic factors include a diagnosis of lung cancer, visceral or brain metastasis and pathologic fracture. Poor nutrition and immunosuppression have been shown to increase the

incidence of complications. Complete preoperative paraplegia is accepted as a poor prognostic factor for neurological recovery. Normalizing total lymphocyte count, albumin and transferrin levels before surgery lowers the risk of complications [9].

We found that 60% of patients who underwent preoperative radiation treatment were still alive 1 year after surgery. It is generally assumed that radiation therapy is a risk factor for postoperative complications because of bone marrow suppression resulting in delayed wound healing and increased susceptibility to infection. Preoperative radiation therapy for patients who have spinal instability or collapse, spinal cord compression caused by bone fragments or rapidly progressive neurological deficits should be avoided [8].

Social security costs

Lodging costs accounted for the majority of the social security expense of which the length of patient stay was the primary driver. Drug costs represented a greater proportion of total social security expenditure (ST: 19%, SF: 17%) compared to 6 and 9% in the cost of physiotherapy for ST and SF, respectively. Minimizing the complications of immobilization such as deep venous thrombosis and pneumonia is warranted by initiating physical therapy as soon as medically possible [1].

Return to work

The percentage of patients employed within 1 year after surgery for SF or tumor was 90%. This figure may be overinflated since only patients still alive during the follow-up period were included. The strongest predictor of employment was the length of period of work incapacity before intervention. This corresponds with the findings of Burnham et al. where the strongest predictor identified was pre-injury employment. They suggest that the barriers that facilitate employment post-SF are more psychological than physical. Self-employment appeared to facilitate a work-oriented mindset [1, 7]. Negative predictors for return to work after SF include pain, prolonged stay in intensive care unit and high spinal injury level. High-level spine fracture victims are more likely to be off work at 1 year postinjury because of polytrauma and neurological injury [4–6]. This could not be verified in our study because of the lack of information on the level of spinal injury.

Conclusion

This study represents the first multicenter evaluation of the outcome and in-hospital cost after surgery for SF and ST in

Table 1 Summary of logistic regression analysis predicting 1 year return to work after controlling for occupation, age, surgeon, gender, type of surgery and sick leave prior to surgery

	<i>B</i>	SE	Wald	df	Sig.	exp(<i>B</i>)	95.0% CI for exp(<i>B</i>)	
							Lower	Upper
Occupation								
Blue collar worker			11.548	2	0.003			
Self-employed	−0.705	0.347	4.134	1	0.042	0.494	0.250	0.975
White collar worker	0.728	0.329	4.890	1	0.027	2.072	1.086	3.950
Age								
0–40 years			6.001	2	0.050			
30–40	0.676	0.375	3.252	1	0.071	1.965	0.943	4.097
40–65	0.857	0.351	5.981	1	0.014	2.357	1.186	4.686
Surgeon								
General surgeon			1.213	2	0.545			
Neurosurgeon	0.476	0.433	1.210	1	0.271	1.610	0.689	3.759
Orthopedic	0.358	0.475	0.569	1	0.451	1.431	0.564	3.632
Female/male	0.309	0.268	1.332	1	0.249	1.362	0.806	2.301
Tumor/fracture	0.490	0.300	2.666	1	0.103	1.632	0.906	2.940
Sick leave								
>3 months			79.462	2	0.000			
0–1 months	2.379	0.289	67.694	1	0.000	10.792	6.123	19.019
1–3 months	2.541	0.416	37.294	1	0.000	12.698	5.617	28.705
Constant	−0.688	0.535	1.654	1	0.198	0.502		

Belgium. This study may prove useful in a number of ways. Patients are unlikely to resume work after surgery after having already incurred preoperative work absence of more than 3 months. They present high-risk cases for spinal surgeons with regard to successful functional recovery. Knowledge of the cost of in-hospital care and its relevant constituents is a prerequisite for the economic evaluation of new and existing interventions in spinal surgery. The in-hospital cost of surgery for SF or ST may be substantially offset by the decrease in hospital stay.

Conflict of interest statement None of the authors has any potential conflict of interest.

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