



The Impact of Neurosurgical Complications on Patients' Health Status: A Comparison Between Different Grades of Complications

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■ **OBJECTIVE:** The aim of this article is to investigate the frequency of neurosurgical complications according to Landriel-Ibañez Classification and their impact on patients' health status.

■ **METHODS:** Patients undergoing neurosurgical procedures were enrolled in an observational longitudinal study at Neurological Institute Carlo Besta from January 2012 to September 2013. We evaluated patients' health status before surgery, at discharge, and follow-up with the Karnofsky Performance Status Scale (KPS), whereas the Landriel-Ibañez Classification was used to record complications. Descriptive statistics were performed to illustrate the distribution of sociodemographic and clinical data. We used nonparametric tests to compare KPS scores of patients with different grades of complication and to evaluate the differences between preoperative KPS scores, KPS scores at discharge and follow-up. The effect sizes were also calculated.

■ **RESULTS:** We enrolled 1008 patients. We registered 228 complications (139 grade 1 complications, 63 grade 2 complications, 20 grade 3 complications, and 6 grade 4 complications). All patients with a complication showed KPS scores at discharge that were lower than preoperative scores and KPS scores at follow-up greater than scores at discharge. After patients with grade 4 complications, who had the worst outcomes, those with grade 3 complications were the most compromised after surgery whereas patients with grade 2 complications seemed to have a better health status than patients with grade 1 complication.

■ **CONCLUSIONS:** Our study highlights the impact of neurosurgical complications on patients' life and

contributes to the debate on how define and classify adverse events because a classification only based on treatment seems to be not adequate.

INTRODUCTION

The evaluation and classification of adverse events play an important role both in terms of the outcome of the neurosurgical procedure and in terms of the management of patients who can be involved in different treatment plan after discharge from hospital. In fact, patients can start further treatment—surgical, pharmacologic, or rehabilitative—or can need only periodic medical examinations. Therefore, postoperative complications represent an important issue for the improvement of safety and quality of surgical procedure (1-3, 18) and also should be taken into account for their impact on hospital costs (6, 21).

We adopted the classification of complications recently proposed by Landriel Ibañez and the definition of complication as “any deviation from the normal postoperative course occurring within 30 days of surgery” (12). This system, based on the kind of treatment required by the specific complication, is derived from the Dindo proposal for adverse events in abdominal surgical procedures (7). This classification is simple and practical to use also because the information on the type of treatment is often recorded in clinical practice and it is easy to recover after surgery.

The aim of this study was to investigate the impact of neurosurgical complications on patients' health status as well as to analyze their frequency in a sample of patients admitted at Neurological Institute Carlo Besta. In particular, we wanted to evaluate the health status of patients with neurosurgical complications before surgery, at discharge and follow-up (after approximately three months from surgery) and to compare the severity of

Key words

- Classification
- Health status
- KPS
- Neurosurgical complications

Abbreviations and Acronyms

EF: Effect size

KPS: Karnofsky Performance Status Scale

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different grades of complication in terms of their impact on patients' life.

MATERIALS AND METHODS

Patients undergoing neurosurgical procedures were enrolled consecutively in an observational longitudinal study at Neurological Institute Carlo Besta from January 2012 to September 2013. The patients included had cerebrovascular diseases (e.g., aneurysm, cavernous hemangioma, arteriovenous malformations, ischemic cerebral disease requiring by-pass procedure), brain tumors (e.g., adenomas, craniopharyngioma, meningioma, gliomas, neurinomas), spinal degenerative diseases (e.g., disc herniation, stenosis, spinal instability), spinal vascular diseases, spinal tumors, and other kind of diagnosis (e.g., hydrocephalous and Arnold Chiari syndrome). Only elective surgery was performed.

Sociodemographic, clinical, neurological, and neurosurgical data were collected by neurosurgeons in our protocol and database (Neurosurgical Complications Protocol and Database Besta) previously described (8). All patients underwent a physical examination on admission to hospital, before discharge, and after approximately 3 months from surgery, at which their health status was evaluated with Karnofsky Performance Status Scale (KPS) by neurosurgeons. KPS is a clinical score obtained from a numerical scale from 0 to 100 representing a patient's ability to perform daily and working activities, self-care, and the need for assistance. Greater scores suggest a better functional status (11). Health status at 3 months was evaluated by telephone interview if patients did not undergo the follow-up visit. According to the classification of Landriel Ibañez, neurosurgical complications were registered at discharge as mild (Grade 1: nonlife-threatening complications treated without invasive procedures), moderate (Grade 2: complications requiring invasive management), severe (Grade 3: life-threatening adverse events requiring treatment in an intensive care unit), and complications resulting in death (Grade 4) (12). Because KPS was determined by the neurosurgeons who operated the patient, they were not blinded to the complications.

This study was approved by the Ethical Committee of Neurological Institute C. Besta IRCCS Foundation Milan, Italy, and written informed consent was obtained from all patients.

This study was performed in accordance with Helsinki Declaration, as modified by 59° General Assembly of the World Medical Association, Fortaleza, Brazil, October 2013.

Statistical Analyses

Descriptive statistics were performed to illustrate the distribution of sociodemographic and clinical data, as well as the classification of complications and KPS scores. We reported mean KPS scores before surgery, at discharge, and follow-up for each grade of complications. Mean change in KPS scores also was described for each group of complication calculating the difference between preoperative KPS scores and KPS scores at discharge (Preoperative-Discharge), KPS scores at discharge and follow-up KPS scores (Discharge-Follow up), and finally between preoperative KPS scores and follow-up KPS scores (Preoperative-Follow up). Positive change in KPS scores was indicative of an improvement in the health status

whereas negative change was suggestive of a worsening in the health status.

Comparisons of change in KPS scores, preoperative KPS, KPS at discharge, and KPS at follow-up scores between Grade 1, Grade 2, and Grade 3 complications were performed by the use of Kruskal-Wallis statistic and post-hoc Mann-Whitney U test with Bonferroni adjustment to reduce type I error caused by multiple comparisons.

Friedman's analysis of variance with Wilcoxon post hoc test was used to evaluate the differences in the health status measured with KPS scale between preoperative period, discharge, and follow-up in each group of complication. Furthermore, the magnitude of the change in KPS scores was measured calculating the effect sizes (ES) with the method of Cohen for paired samples: $ES > 0.2$ was considered small, $ES > 0.5$ medium, and > 0.8 large (5). We used the ES as an absolute value.

We always used nonparametric tests since p-p plot showed that data were not normally distributed and missing data were excluded from the analyses (i.e., listwise deletion of missing data). All statistical analyses were performed using SPSS v. 18.0 (SPSS Institute, Cary, North Carolina, USA).

RESULTS

A total of 1008 consecutive cases were enrolled in this study: the mean age was 53 (SD 17; range = 1–87), 508 cases (50.4%) were female, 428 (42.5%) had brain tumor, 144 (14.3%) cerebrovascular disease, 13 (1.3%) spinal-vascular disease, 306 (30.4%) spinal degenerative disease, 41 (4.1%) spinal tumor, and 76 (7.5%) other diseases (Table 1).

We registered a complication in 228 patients (22.6%), 203 (89%) with brain disease, and 25 (11%) with spinal disease: 139 (61%) were Grade 1 complications (101 Grade 1a and 38 Grade 1b), 63 (27.6%) Grade 2 complications (20 Grade 2a and 43 Grade 2b)

Table 1. Descriptive Statistics of Demographic and Clinical Variables

Variable	Frequency	Percentage
Sex		
Male	500	49.6%
Female	508	50.4%
Age (years)		
Mean	53	
SD	17	
Range	1–87	
Disease		
Brain tumor	428	42.5%
Cerebrovascular	144	14.3%
Spinal-vascular	13	1.3%
Spinal degenerative	306	30.4%
Spinal tumor	41	4.1%
Others	76	7.5%

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