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Editor
Nancy E. Epstein, MD
Clinical Professor of Neurological Surgery, School of Medicine, State U. of NY at Stony Brook

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Original Article

Perception of complications by spine surgeons

Asdrubal Falavigna[1], Jefferson Dedea[2], Alfredo Guiroy[3], Giovanni Barbanti Brodano[4]

[1]Department of Neurosurgery, University of Caxias do Sul, [2]Laboratory of Clinical Studies and Basic Models on Spinal Cord Pathologies, University of Caxias do Sul, Caxias do Sul, Rio Grande do Sul, Brazil, [3]Department of Orthopedics, Hospital Español, Mendoza, Argentina, [4]Departmemnt of Oncological and Degenerative Spine Surgery, IRCCS Istituto Ortopedico Rizzoli, Bologna, Italy.

E-mail: Asdrubal Falavigna - asdrubalmd@gmail.com; Jefferson Dedea - jdedea@ucs.br; Alfredo Guiroy - alfreguiroy@hotmail.com; Giovanni Barbanti Brodano - giovanni@barbantibrodano.com

***Corresponding author:**
Asdrubal Falavigna, MD, PhD, Coordinator of Post-Graduation Program in Medicine. Departament of Neurosurgery of the University of Caxias do Sul. Rua General Arcy da Rocha Nóbrega, 401/602 CEP: 95040-290, Caxias do Sul – RS, Brazil.

asdrubalmd@gmail.com

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ABSTRACT

Background: The perception of major versus minor complications may vary according to surgeons, institutions, and different specialties. Here, we analyzed the geographic distribution of the different types/severities of the most frequent complications in spinal surgery, and assessed how the perception of spine surgeons about postoperative complications differed.

Methods: We performed a cross-sectional study using a questionnaire, we developed to encompass different clinical scenarios of surgeons' perceptions of spine surgery complications. The survey involved the members of AOSpine Latin America (LA) (January 28, 2017–March 15, 2017). The main variables studied included: specialty, age, years of experience, country, individual surgeon's perception of different clinical scenarios, and the surgeon's classification of complications for each scenario (e.g., major, minor, or none). Our results from LA were then analyzed and compared to North American (NA) responses.

Results: Orthopedic surgeons represented about 58.2% (n = 412) of the 708 questionnaires answered. Of interest, 45.6% (n = 323) of those responding had >10 years of experience. The countries analyzed included Brazil (31.5%), Mexico (17.5%), Argentina (14.4%), Colombia (8.0%), and Venezuela (7.6%). Four of the 11 scenarios showed consensus in the results (e.g., average being over 82.5%). A tendency toward consensus was present in 45.4% of the clinical cases, while two out of 11 clinical cases did not present a consensus among surgeons. Of interest, the perception of complications was similar between cohorts (LA 85% vs. NA 80%).

Conclusion: Significant consensus in the perception of complications was observed in most of the analyzed scenarios for both LA and NA. However, within the LA data, responses to different clinical scenarios varied.

Keywords: Complications, Neurosurgeon, Orthopedist, Spine, Spine surgery

INTRODUCTION

The incidence of complications after spine surgery is an important parameter to be consider for cost benefits analyses and the decision-making process.[3]

Information is critical to establish criteria for reporting complications of spine surgery. However, in most of the spine centers worldwide, the perception of major versus minor complications can vary according to the surgeons, institutions, and different orthopedics and neurosurgery spinal specialties.[5] Therefore, here the authors performed a survey to evaluate how the specialists in

Latin America (LA) perceived spinal complications in the postoperative period.

MATERIALS AND METHODS

Study design

A cross-sectional study was performed using a spine surgery complications survey. The questionnaire was sent to spine surgeons who were members of AOSpine LA.

Spine surgery complications questionnaire

The questionnaire was sent to members of AOSpine LA (January 28, 2017–March 15, 2017). The e-mail contained a questionnaire translated from English to the Portuguese and Spanish (e.g., Lebude *et al*.).[8]

It included 17 questions; six related to surgeon demographics and 11 to clinical scenarios of complications adverse events after spine surgery [Table 1]. The variables analyzed included country, age, specialty, years of practice, number of surgeries per year, percentage of surgery requiring instrumentation, surgeon's perception on different clinical scenario, and the surgeon's classification of each scenario as major, minor, or no complications. Data from countries with more than 50 respondents were analyzed and compared with the North American (NA) study.[8]

Scenario of spine surgery complications

To evaluate a spine surgeon's perception of postoperative complications, we developed a survey utilizing 11 different scenarios, grading each as major, minor, or none [Table 1]. These complications included dysphagia, limitation of movement, myocardial infarction, ulcers, C5 paralysis, deep vein thrombosis, systemic arterial infection, urinary tract infection, wound inflammation, poor positioning of the screw, and bleeding. The clinical scenarios were analyzed in three different categories; established consensus (>80%), consensus tendencies (between 60% and 80%), and no consensus (<60%). The questionnaire was sent to 1445 members of AOSpine LA; 708 surgeons answered (48.9%).

Table 1: Complication scenarios.

1. A 35-year-old patient presents with cervical myelopathy and severe cervical spinal cord compression from a C5-6 disc herniation. Anterior cervical discectomy and fusion are performed resolving the myelopathy symptoms. The patient suffers from dysphagia for 4 weeks after surgery, which resolves without intervention
2. A 75-year-old patient presents with significant basilar invagination with cord compression and myelopathy symptoms. Surgery through an occiptocervical fusion is completed. The patient notes significant decrease in cervical range of motion after the surgery
3. A 60-year-old male presents with a vertebral body metastasis at L3 with severe epidural canal compromise and significant pain. He has no other metastatic lesion and no known primary lesion. He has a positive preoperative stress test. He chooses surgical treatment for his metastatic lesion. Postoperatively, the patient suffers a myocardial infarction requiring lengthy ICU management
4. A 40-year-old female presents with a symptomatic lumbar disc herniation. She fails conservative treatment and is operatively treated with a lumbar discectomy. She develops a postoperative deep wound infection, requiring operative irrigation, and debridement and postoperative IV antibiotics. She enjoys a full recovery
5. A 55-year-old male with ossification of the posterior longitudinal ligament presents with significant cervical myelopathy. He is treated through a cervical laminoplasty. He enjoys improvement in his myelopathy symptoms, but develops a postoperative C5 palsy. This palsy resolves after 6 weeks
6. A 60-year-old female suffers a C6 fracture in a motor vehicle accident. She is surgically stabilized through an anterior approach. She is neurologically intact after the accident and remains so after surgical treatment. She develops a postoperative DVT, requiring anticoagulation for 6 months. She does not suffer a pulmonary embolus
7. A 35-year-old female develops spinal cord compression at T6 secondary to a breast metastasis. She undergoes an anterior and posterior thoracic reconstruction. Postoperatively, she develops an infection at her arterial line site and receives a short course of IV antibiotics
8. A 70-year-old female undergoes a lumbar decompression and stabilization for severe stenosis. She suffers urinary retention postoperatively and develops a urinary tract infection. She is successfully treated with oral antibiotics, and otherwise enjoys complete recovery from her surgery
9. A 40-year-old male undergoes surgical treatment for a symptomatic lumbar disk herniation. He develops erythema at his operative site 2 week postoperative. He is treated with oral antibiotics and recovers completely
10. A 30-year-old female undergoes surgery for an isthmic spondylolisthesis recalcitrant to conservative treatment. Postoperative plain films show lateral malposition of one pedicle screw. The patient has no symptoms. The patient is returned to the OR and the screw is repositioned
11. A 40-year-old female undergoes an anterior thoracic approach for a calcified disk herniation producing cord compression. She suffers significant blood loss from accidental injury to a segmental vessel; she requires transfusion postoperatively. She otherwise recovers completely from her surgery

DVT: Deep venous thrombosis, ICU: Intensive care unit, IV: Intra-venous, OR: Operating room

General information

The number of participants in each country is presented in [Table 2]. The majority of the participants were orthopedic surgeons (58.2%) and had been in practice for more than 6 years (63%) [Table 3]. Most respondents had <100 surgeries per year (70.4%) and many spine surgeons (53.4%) performed instrumented fusion in <50% of surgeries. In addition, 84.7% of surgeons were working in University Hospitals.

Table 2: Respondents from Latin America (*n*=708).

Country	Percentage
Brazil	31.49 (223)
Mexico	17.51 (124)
Argentina	14.40 (102)
Colombia	8.05 (57)
Venezuela	7.62 (54)
Chile	4.37 (31)
Peru	3.24 (23)
Cuba	2.25 (16)
Ecuador	1.55 (11)
Guatemala	1.55 (11)
Uruguay	1.55 (11)
Bolivia	1.27 (9)
Panama	1.12 (8)
Costa Rica	0.98 (7)
Paraguay	0.84 (6)
Dominican Republic	0.84 (6)
Nicaragua	0.70 (5)
Honduras	0.42 (3)
El Salvador	0.14 (1)

Table 3: General demographic data of survey respondents from Latin America (*n*=708).

Specialty	
Neurosurgeon	296 (41.8%)
Orthopedic surgeon	412 (58.2%)
Years in practice	
1–3 year	144 (20.3%)
4–6 year	118 (16.7%)
6–10 year	123 (17.4%)
>10 year	323 (45.6%)
Number of spine surgeries per year	
<50	207 (29.2%)
50–100	292 (41.2%)
100–200	155 (21.9%)
>200	54 (7.6%)
Estimated percentage of surgeries requiring instrumented fusion	
<25%	130 (18.4%)
25–50%	248 (35.0%)
50–75%	233 (32.9%)
>75%	97 (13.7%)
Local (place) of work	
University hospital	226 (31.9%)
Private hospital	108 (15.3%)
Both	374 (52.8%)

Statistical analysis

The probability of considering an event as a complication or not and the severity of the complication were analyzed; the odds ratio was defined in each clinical scenario. Statistical analysis was performed using the SPSS program (IBM v22.0, Chicago, IL). Categorical data were presented as counts and percentages and compared using the Chi-squared test. Proportion pairwise comparisons were conducted among groups using Bonferroni *post hoc* corrections. The significance level was set at $P < 0.05$. All data have been kept confidential.

RESULTS

Scenario of spine surgery complications

Those responding the LA questionnaire in descending order included Brazil (n = 223), Mexico (n = 124), and Argentina (n = 102). Fewer responded from Colombia (n = 57) and Venezuela (n = 54) (e.g. the countries showing more than 50 respondents vs. the NA study; n = 229) [Tables 2 and 4].[9]

Scenarios with established consensus (>80%), tendency toward consensus (60–80%) and without established consensus (<60%)

Clinical scenarios 3, 5, 8, and 9 showed a general consensus in the responses (e.g., superior to 82%) [Table 4]. There was a trend toward consensus in LA of clinical scenarios 1, 2, 4, 7, and 10 [Table 4]. There was no consensus between clinical scenarios 6 and 11.

Comparisons of responses between LA and NA

Among the analyzed LA and NA groups, the perception of complications was similar (e.g. LA 85% and NA 80%). However, the forms of classification into major, minor, or noncomplication categories were not well defined.

In scenario 1, 77% of LA versus 58% of NA surgeons defined dysphagia as a minor complication (consensus). In scenario 3, myocardial infarction was considered a major complication for 76% for NA versus 82% of LA surgeons (consensus). However, there was no consensus for scenario 6 deep venous thrombosis (DVT); 71% from NA versus 53% of surgeons from LA classified it as a minor complication.

DISCUSSION

In the present study, we sought to understand how the spine surgeons identify and classify postoperative complications. In general, spine surgeons from LA and NA had the perception that complications were present in 82.3%, LA 85.3%, and

Table 4: Results of questions in percentage.

	Total	Subtotal	Brazil	Mexico	Argentina	Colombia	Venezuela	USA	*P*
Scenario 1									<0.001
No complication	25	19	16[a]	23[a]	20[a]	23[a,b]	13[a]	40[b]	
Minor complication	71	77	78[a]	75[a]	76[a]	72[a,b]	83[a]	58[b]	
Major complication	4	4	5[a]	2[a]	4[a]	5[a]	4[a]	2[a]	
Scenario 2									0.002
No complication	80	77	81[a]	75[a,b]	77[a,b]	84[a,b]	59[b]	87[a]	
Minor complication	15	17	14[a]	16[a,b]	19[a,b]	14[a,b]	33[b]	11[a]	
Major complication	5	6	5[a]	9[a]	4[a]	2[a]	7[a]	2[a]	
Scenario 3									<0.001
No complication	11	13	12[a,b]	10[a,b]	14[a,b]	18[a,b]	20[b]	7[a]	
Minor complication	8	5	7[a]	3[a]	2[a]	4[a,b]	7[a,b]	17[b]	
Major complication	81	82	81[a]	87[a]	84[a]	79[a]	72[a]	76[a]	
Scenario 4									0.029
No complication	0	0	0[a]	0[a]	0[a]	0a	0[a]	1[a]	
Minor complication	34	35	34[a,b,c]	34[a,b,c]	44[c]	16[b]	43[a,c]	32[a,b,c]	
Major complication	66	65	66[a,b,c]	66[a,b,c]	56[c]	84[b]	57[a,c]	67[a,b,c]	
Scenario 5									0.058
No complication	7	5	6[a]	5[a]	5[a]	2[a]	6[a]	12[a]	
Minor complication	79	81	81[a]	83[a]	80[a]	74[a]	83[a]	73[a]	
Major complication	14	14	13[a]	12[a]	15[a]	25[a]	11[a]	15[a]	
Scenario 6									<0.001
No complication	6	7	8[a]	6[a]	4[a]	5[a]	13[a]	5[a]	
Minor complication	59	53	62[a,b]	38[c]	55[a,b,c]	46[b,c]	54[a,b,c]	71[a]	
Major complication	35	40	30[a,b]	56[c]	41[b,c]	49[b,c]	33[a,b,c]	24[a]	
Scenario 7									0.155
No complication	9	10	8[a,b]	10[a,b]	10[a,b]	9[a,b]	20[b]	5[a]	
Minor complication	78	77	77[a]	77[a]	79[a]	79[a]	71[a]	81[a]	
Major complication	13	13	15[a]	13[a]	11[a]	12[a]	9[a]	14[a]	
Scenario 8									0.388
No complication	17	16	16[a]	17[a]	14[a]	12[a]	18[a]	19[a]	
Minor complication	81	81	80[a]	81[a]	83[a]	82[a]	81[a]	80[a]	
Major complication	2	3	4[a]	2[a]	3[a]	5[a]	0[a]	1[a]	
Scenario 9									0.013
No complication	15	13	13[a]	15[a]	17[a]	5[a]	7[a]	20[a]	
Minor complication	84	85	87[a]	82[a]	82[a]	89[a]	91[a]	80[a]	
Major complication	1	2	0a	2[a]	1[a]	5[a]	2[a]	0[a]	
Scenario 10									<0.001
No complication	9	10	18[a]	8[a, b]	7[a, b]	2[b]	2[a, b]	5[b]	
Minor complication	65	67	63[a]	66[a]	72[a]	60[a]	72[a]	62[a]	
Major complication	26	23	19[a]	26[a,b]	21[a,b]	39[b]	26[a,b]	33[b]	
Scenario 11									0.006
No complication	15	13	15[a]	12[a]	15[a]	7[a]	9[a]	21[a]	
Minor complication	51	49	48[a]	45[a]	52[a]	44[a]	56[a]	54[a]	
Major complication	34	38	36[a,b]	43[b]	33[a,b]	49[b]	35[a,b]	25[a]	

NA 79.7%, of the clinical scenarios with 81.8% of consensus between the regions.

Complications in spinal surgery have a great impact on patient outcome and health-care costs, which increase exponentially according to severity.[1,9] In 2008, the United States performed 413,000 spine surgeries at an estimated hospital cost of US$ 33.9 billion.[6] Mortality over the same period remained relatively constant compared to the previous years, with rates corresponding to 0.46%, 1.2%, and 0.14% for cervical, thoracic, and lumbar surgeries, respectively.[6] The total average hospital charges for adult patients with up to three complications can reach US$ 1.18 million.[10]

The classification of major, minor, or no complications usually is performed by the knowledge and perception of the spine surgeon.

Based on the current literature data, Lebude *et al*.[8] propose the following definitions for postoperative complications:

Major complication

It is defined as a severe postoperative adverse event that produces permanent damaging effect or requires surgical reintervention. These adverse events occur within 30 days of surgery, having a specific connection with the surgical procedure.

Minor complication

A postoperative adverse event that produces only a transient detrimental effect, including adverse medical events in the perioperative period.

Consensus or not between NA and LA

The presence of a consensus of complications among the LA and NA cohorts was presented in 8 (72.7%) of the 11 clinical scenarios [Figure 1].

NA and LA did not perceive the presence of complications in clinical scenario 2 that discusses the limitation of movement after occipitocervical fusion. It was considered that the limitation of movement is expected after this type of procedure.

Among the scenarios that presented divergence among the cohorts, are scenario 1, which evaluated the dysphagia in the postoperative period. Dysphagia after anterior cervical approach can be expected in the 1st week due to the retraction of the larynx and adjacent organs during surgery.[7] In this way, dysphagia can be considered as an expected symptom (41% in NA vs. 19% in LA) or complication (81% LA vs. 59% NA). The presence of cardiac complications is more common in patients with a history of cardiac problems.[2] Myocardial infarction is considered a major complication by 82% of LA surgeons and 76% for NA.

DVT is described as a severe postoperative complication, and the use of platelet antiaggregants and anticoagulants is aimed at decreasing the number of DVT events. Lack of movement for long periods is one of the main factors for the development of DVT in patients who need to undergo spinal surgery. Thus, it is necessary to use medications and monitoring to avoid the present adverse event.[2] DVT, scenario 6, was considered a complication by both the NA (94%) and LA (93%) regions, but divergence was observed in the perception as minor (LA 53% vs. NA 71%) or a major complication (LA 40% vs. NA 24%).

Although there was divergence between LA and NA cohorts in the clinical scenarios presented, responses were similar in 8 of 11 cases. However, the way both regions perceive and classify complications varies according to the individual analysis and judgment of each spine surgeon.

Chen *et al*.[4] recently conducted an interesting experiment. They compared the complications rate among groups of patients undergoing spine, hip, knee, and shoulder surgery; the study was a 10-week prospective study where SAVES V2 and OrthoSAVES were used by six orthopedic surgeons and two independent, non-

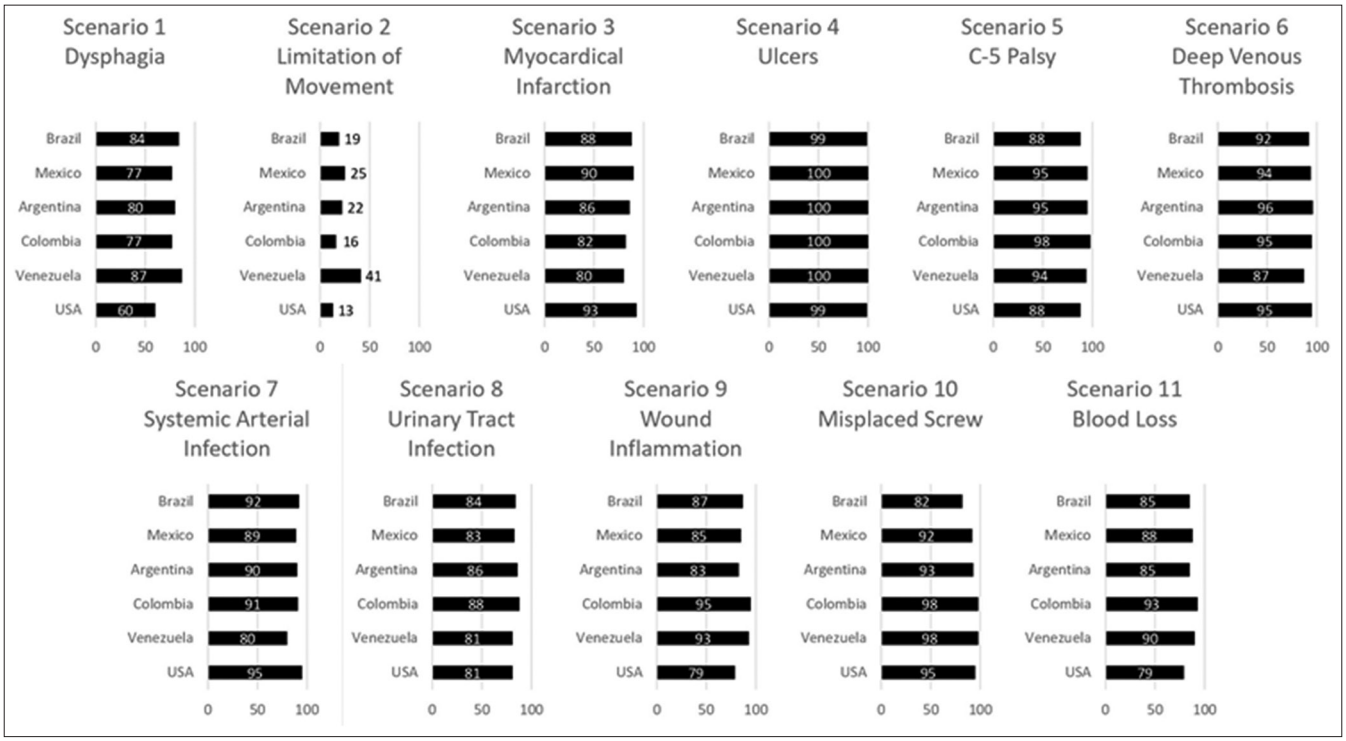

Figure 1: Percentage of answers of major and minor complications according with the scenarios presented.

MD clinical reviewers to record adverse events after all elective procedures. For a spine surgeon, the first important result of the study was the highest rate of complications in the spine surgery group compared to the other surgeries, but the most important observation of this study was that overall, 99 adverse events were captured by the reviewers, compared with 14 captured by the surgeons ($P < 0.001$); surgeons adequately captured major adverse events, but failed to record minor events that were captured by the reviewers; in spine surgery group, reviewers captured 45 adverse events versus eight captured by surgeons.

The study by Chen *et al*.[4] confirmed the rate of complications as a problem to be urgently faced in spine surgery and highlight the inadequate figure of the surgeon as complications evaluator. Is seems that spine surgeons underestimate the complications impact on the patients and health system, and this could be a reason to explain the so high rate of complications in spine surgery.

One limitation of the study is that there was a small percentage of respondents (708 out of 1445 or 48.9%). Those who did not respond could have been either more or less knowledgeable. Nevertheless, 708 is still a large number of respondents and enough to show that surgeons' perception regarding definition of complication after spine surgery is woefully lacking.

The better capture and perception of complications in spine surgery may lead to improvements in medical services and management strategies in the postoperative period. Studies are necessary to establish an understanding of perception to improve the management strategies and guide future research. To do that, we are currently gathering similar data regarding surgeons in other regions of the world. Our findings strongly highlight the importance of defining complications and have a similar classification.

CONCLUSION

A significant consensus was observed in the perception of the presence of complications in most of the scenarios analyzed but not for classification in major and minor complications.

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Declaration of patient consent

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Conflicts of interest

There are no conflicts of interest.

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