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ORIGINAL ARTICLE - SPINE - OTHER

Enhanced recovery after spine surgery—a multinational survey assessing surgeons' perspectives

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Abstract

Background Enhanced Recovery After Surgery (ERAS) is the object of numerous publications in various surgical fields. Still, its value in spine surgery is not as recognized as it is in other surgical domains. Our aim was to report neurosurgeons' opinions about ERAS in spine surgery.

Methods From December 2019 to January 2020, members of the European Association of Neurosurgical Societies were asked to complete an online questionnaire regarding ERAS in spine surgery.

Results $N = 234$ participants responded to the survey (60% spine neurosurgeons; 22.6% working in private practice). Thirty-two percent reported to have more than 20 years of experience, followed by surgeons having between 5 and 10 (27.4%), 10–15 (17.9%), 15–20 (12%), and 0–5 years (10.7%). Gender distribution (12% vs 27% female gender, $p = 0.04$), private practice activity (28% vs 14%, $p = 0.01$), familiarity with the ERAS concept (57.4% vs 27%, $p < 0.0001$), and its implementation in the daily clinical practice (47.5% vs 18.3%, $p < 0.0001$) were statistically different between spine and general neurosurgeons. 54.7% of the surgeons were unfamiliar with ERAS in spine surgery. 63.7% considered ERAS as a progress; 36% declared to implement ERAS in their daily clinical practice. 1.7% reported ERAS as a decrease in the quality of management. 6.8% considered ERAS as not having an impact on patient care; 27.8% had no opinion. There were no differences in opinion on ERAS and its implementation between surgeons working in private and public hospitals. 69.5% of the spine surgeons considered ERAS having a positive impact on patient management, versus 55% of non-spine surgeons ($p = 0.02$).

Conclusions Efforts are necessary to promote minimal invasive pre-, intra-, and postoperative workflow to improve patient management and reduce complications or side effects particularly adapted to spinal surgery. Specificities of spine patients, in terms of chronic pain, pre- and postoperative pain management, and psychological issues have to be considered.

Keywords Enhanced Recovery After Surgery · ERAS · Spine surgery · Neurosurgery

Introduction

The concept of Enhanced Recovery After Surgery (ERAS) was introduced by Kehlet et al. in 1997 [1]. Since then, ERAS has been the object of more than 3000 PubMed-listed publications in various surgical fields [2]. To date, ERAS is promoted by national and international surgical societies and hospitals. In theory, the implementation of ERAS in clinical practice is supposed to improve patients' preparation for the surgery, as well as increasing their comfort and satisfaction by reducing the overall invasiveness of the surgical procedure [3] and complications. Eventually, a shortened length of stay (LOS) would result from these measures.

Even though ERAS is primarily a concept developed for providing better perioperative management of patient candidates to spinal procedures, it has economic implications as well. The ERAS concept, on the one hand, allows for reduction of perioperative—sometimes unnecessary—procedures which themselves induce costs (either in the form of additional care\ or in terms of complications). On the other hand, ERAS allows better regulation of financial resources through the development of patient itineraries and protocols, avoiding so-called money-driven medicine policies [4, 5].

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Through elaboration of checklists (pre-admission counseling, physical therapy, dietary assessment), implementation of surgical techniques (minimal invasive surgery), as well as anesthesia procedures (reduced opioid pain control), various steps are implemented throughout the pre-, intra-, and postoperative periods, as discussed previously [2].

Despite the abundant literature in many surgical fields, the concept of ERAS in spinal surgery is still rarely discussed [2, 6]. To date, sporadic reports on ERAS, lesser invasive surgical techniques, outpatient surgery, as well as anesthesia procedures tend to demonstrate the benefits for patients, caregivers, and healthcare systems [6–15]. Still, the value of ERAS in spine surgery seems not to be as recognized as it is in other surgical domains, since its implementation in daily clinical practice is marginal in European public and private hospitals.

Our aim was to report neurosurgeons' opinions about ERAS in spine surgery, by the mean of a multinational survey spread online (SurveyMonkey®) through the European Association of Neurosurgical Societies (EANS) mailing list.

Methods

From December 2019 to January 2020, members of the EANS were asked to complete an online questionnaire (Table 1) regarding ERAS in spine surgery, via the SurveyMonkey® online platform. The participants were contacted via e-mail, through the mailing list of the association, which counts for 1800 individual members.

Statistical analysis

The statistical analysis was performed using GraphPad Prism 8 v8.3.1 (GraphPad Software Inc., San Diego, CA). The statistical significance threshold was set at $p = 0.05$. A standard chi-square analysis was used to compare raw distributions.

Results

Cohort characteristics

A total of $N = 234$ participants responded to $N = 9$ questions after a brief introduction on ERAS in spine surgery. $N = 141$ (60%) were spine neurosurgeons, $N = 181$ (77.4%) worked in Public Academic Hospitals, and $N = 36$ (15.4%), $N = 156$ (66.7%), and $N = 42$ (17.9%) were, respectively, Trainees/Fellows, Board-Certified Neurosurgeons, and Chairmen.

Data on the cohort characteristics are summarized in Table 2. The age range of the overall cohort was distributed as follows: $N = 16$ (6.8%) were 20–30 years old, $N = 87$ (37.2%) were 30–40, $N = 62$ (26.5%) were 40–50, $N = 38$ (16.3%) were 50–60 and $N = 31$ (13.2%) were older than 60.

Table 1 Summary of the questions of the survey and the responses related

Question	Possible answers
How old are you?	a) 20–30 b) 30–40 c) 40–50 d) 50–60 e) > 60
What is your gender?	a) Male b) Female
How many years have you been in the domain of neurosurgery?	a) 0–5 b) 5–10 c) 10–15 d) 15–20 e) >20
What is your current position?	a) Trainee/fellow b) Board-certified neurosurgeon c) Chairman
Your activity?	a) Private practice b) University hospital
Are you a spine surgeon?	a) Yes b) No
Are you familiar with the concept of ERAS in spine surgery?	a) Yes b) No
Do you apply the concept of ERAS in spine surgery in your daily clinical practice?	a) Yes b) No
In your opinion, ERAS in spine surgery may lead to:	a) A progress towards an improved overall medical and surgical management of patients b) A decrease in quality in terms of patients' surgical and medical management c) Not a major change in patient's management d) No opinion

Regarding the seniority in the neurosurgical domain, the majority of the surgeons reported to have more than 20 years of experience ($N = 75$, 32%), followed by surgeons having between 5 and 10 ($N = 64$, 27.4%), 10–15 years ($N = 42$, 17.9%), 15–20 years ($N = 28$, 12%), and 0–5 ($N = 25$, 10.7%). Women represented 18% and 12% of the overall responders and the spine neurosurgeons, respectively (Table 3).

Overall opinion on ERAS in spine surgery

More than half of surgeons ($N = 128$, 54.7%) were not familiar with the concept of ERAS in spine surgery. The majority of surgeons ($N = 149$, 63.7%) considered ERAS as a progress towards the improved patient management, but only $N = 84$ (36%) surgeons declared to implement ERAS guidelines in their daily clinical practice. A total of $N = 4$ (1.7%) surgeons reported ERAS as a decrease in the quality of management, and $N = 16$ (6.8%) surgeons considered ERAS as not having

Table 2 Characteristics of the $N = 234$ surgeons surveyed

Variable	N (%)
Age	
20–30	16 (6.8)
30–40	87 (37.2)
40–50	62 (26.5)
50–60	38 (16.2)
> 60	31 (13.2)
Tot	234
Gender	
Male	192 (82.1)
Female	42 (17.9)
Tot	234
Years in neurosurgery	
0–5	25 (10.7)
5–10	64 (27.4)
10–15	42 (18)
15–20	28 (12)
> 20	75 (32.1)
Tot	234
Current position	
Trainee/fellow	36 (15.4)
Board-certified neurosurgeon	156 (66.7)
Chairman	42 (17.9)
Tot	234
Activity	
Private practice	53 (22.6)
University hospital	181 (77.4)
Tot	234
Spine surgeon	
Yes	141 (60.3)
No	93 (39.7)
Tot	234

Table 3 Cohort familiarity and rate of implementation of Enhanced Recovery After Surgery as well as opinion on the concept in spine surgery

Familiarity with ERAS	N (%)
Yes	106 (45.3)
No	128 (54.7)
Tot	234
ERAS implementation in DCP	
Yes	84 (35.9)
No	150 (64.1)
Tot	234
Opinion on ERAS	
Progress	149 (63.7)
Decrease in quality	4 (1.7)
Not a major change	16 (6.8)
No opinion	65 (27.8)
Tot	234

ERAS, Enhanced Recovery After Surgery; *DCP*, daily clinical practice

an impact on patient care. Finally, $N = 65$ (27.8%) surgeons had no opinion on ERAS. Responses from the overall cohort on ERAS in spine surgery are presented in Table 3.

Opinion on ERAS in spine surgery among spine and non-spine surgeons

$N = 141$ (60%) were spine neurosurgeons, while $N = 93$ (40%) were general neurosurgeons. The distributions of gender (12% vs 27% female gender, $p = 0.04$), private practice activity (28% vs 14%, $p = 0.01$), familiarity with the ERAS concept (57.4% vs 27%, $p < 0.0001$) and its implementation in the daily clinical practice (47.5% vs 18.3, $p < 0.0001$) were statistically different between spine and general neurosurgeons. A total of 69.5% of spine surgeons considered ERAS having a positive impact on patient management, versus 55% of non-spine surgeons ($p = 0.02$). Results are shown in Table 4.

Opinion on ERAS in private and non-private practices

A total of $N = 53$ (22.6%) surgeons declared to practice in a private facility, most of them being spine surgeons ($N = 40$, 75.5%). There were no differences in opinion on ERAS between surgeons working in private and public hospitals.

Table 4 Results regarding spine surgeons of the overall cohort

Variable	Spine surgeons $N = 141$ N (%)	Non-spine surgeons $N = 93$ N (%)	p
Gender			0.04
Male	124 (87.9)	68 (73.1)	
Female	17 (12.1)	25 (26.9)	
Tot	141	93	
Activity			0.01
Private practice	40 (28.4)	13 (14)	
University hospital	101 (71.6)	80 (86)	
Tot	141	93	
Familiarity with ERAS			< 0.0001
Yes	81 (57.4)	25 (26.9)	
No	60 (42.6)	68 (73.1)	
Tot	141	93	
ERAS implementation in DCP			< 0.0001
Yes	67 (47.5)	17 (18.3)	
No	74 (52.5)	76 (81.7)	
Tot	141	93	
Opinion on ERAS			0.02
Progress	98 (69.5)	51 (54.8)	
Decrease in quality	4 (2.8)	0	
Not a major change	8 (5.7)	8 (8.6)	
No opinion	31 (21.9)	34 (36.6)	
Tot	141	93	

ERAS, Enhanced Recovery After Surgery; *DCP*, daily clinical practice

Surgeons working in private practice did not report to implement ERAS in their daily clinical practice more frequently than surgeons working in public hospitals. Results are shown in Table 5.

Opinion on ERAS among fellows/trainees, board-certified neurosurgeons, and chairmen

Among the Fellows/Trainees, Board-Certified Neurosurgeons, and Chairmen, $N = 19$ (53%), $N = 104$ (66.7%), and $N = 26$ (61.9%) considered ERAS in spine surgery as a progress towards improved management of patients. Results are shown in Table 6.

Table 5 Results regarding surgeons working in private and public facilities

Variable	Private practice	Non-private practice	*p*
Age			0.01
20–30	0	16	
30–40	15	72	
40–50	14	48	
50–60	15	23	
> 60	9	22	
Tot	53	181	
Years in neurosurgery			0.05
0–5	1	24	
5–10	15	49	
10–15	8	34	
15–20	5	23	
> 20	24	51	
Tot			
Spine surgeon			0.01
Yes	40 (75.5%)	101	
No	13	80	
Tot			
Familiarity with ERAS			n.s.
Yes	26	80	
No	27	101	
Tot			
ERAS implementation in DCP			n.s.
Yes	24	60	
No	29	121	
Tot			
Opinion on ERAS			n.s
Progress	31	118	
Decrease in quality	1	3	
Not a major change	3	13	
No opinion	18	47	
Tot			

ERAS, Enhanced Recovery After Surgery; *DCP*, daily clinical practice

Table 6 Opinion on Enhanced Recovery After Surgery of the cohort, according to the seniority of the participants

Opinion on ERAS	Fellow/ trainee	Board-certified	Chairman	*p*
Progress	19 (53%)	104 (66.7%)	26 (62%)	n.s
Decrease in quality	1 (2.7%)	2 (1.3%)	1 (2.4%)	
Not a major change	3 (8.3%)	8 (5.1%)	5 (11.9%)	
No opinion	13 (36.1%)	42 (26.9%)	10 (23.8%)	
Tot	36	156	42	

Discussion

Using a short survey distributed to all members of the EANS, we assessed the general opinion on ERAS in spine surgery among European neurosurgeons. To our knowledge, this is the first study assessing the knowledge of ERAS in spine surgery among neurosurgeons and spine neurosurgeons.

ERAS among neurosurgeons

Among the $N = 234$ neurosurgeons who responded to the survey, only 45.3% were familiar with the concept of ERAS in spine surgery. The majority of the surveyed (63.7%) considered ERAS as a progress towards improved patient management in spine surgery. However, only 36% reported practicing using the ERAS concepts on a daily basis (Fig. 1). These results were surprising, as ERAS promotes the increase of patient comfort, satisfaction, and reduced overall invasiveness of anesthetics and surgical procedures [1]. In this perspective, we expected a greater popularity among neurosurgeons. These results show the mismatch between the surgeons' needs and active search for improvement in patient management and the reality of their daily clinical practice. Finally, we found that despite an increasing interest in the topic, the spread of ERAS in the neurosurgical community is still not optimal.

ERAS among spine neurosurgeons

As ERAS in neurosurgery is exclusively applied to spine surgery to date, we expected spine surgeons to be more aware of the concept. This is the case, as shown in Table 3. Spine neurosurgeons implemented ERAS in their daily clinical practice more often than non-spine surgeons (47.5% vs 18.3%, $p < 0.001$). However, ERAS was not practiced by the majority of the spine surgeons despite a very favorable opinion reported (Fig. 2). Furthermore, spine specialists considered ERAS as an improvement of patient management more frequently than non-spine surgeons (69.5%, vs 54.8%, $p = 0.02$, Table 3). These results corroborate with the context of ERAS, which is more prone to be adapted to spine surgery. However, ERAS is a concept that may apply to cranial

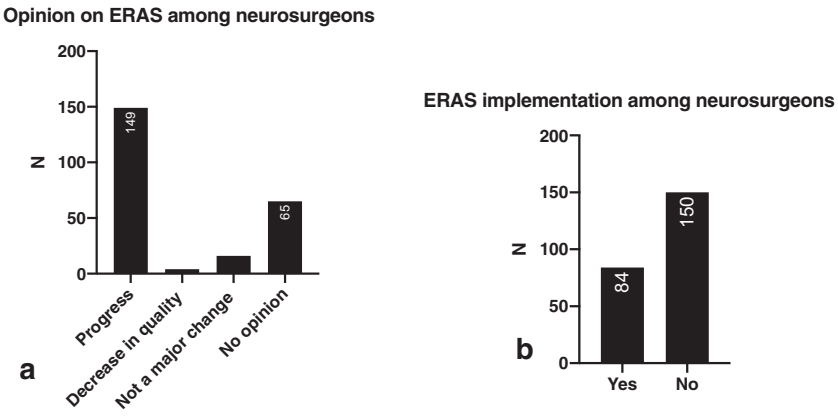

Fig. 1 Opinion on Enhanced Recovery After Surgery in spine among neurosurgeons (a) and implementation of the concept in the daily clinical practice (b). ERAS, Enhanced Recovery After Surgery

surgery, since it promotes lesser invasiveness. To date, we were not able to find any report on ERAS applied to cranial surgery.

ERAS in private practice

As ERAS is a concept promoting lesser invasiveness and accelerated recovery after surgery, its implementation would be expected to be more frequent in private practice. Our results show that surgeons working in private practice were not more familiar with ERAS than surgeons working at public hospitals. Furthermore, ERAS was not implemented more frequently in private practices (Fig. 3). To our knowledge, ERAS in private practice has been reported in instrumented and non-instrumented lumbar spine surgery so far [6, 8].

ERAS and outpatient surgery: Comparison is misleading

Despite that ERAS and outpatient surgery share similar aspects regarding anesthesia management and post-operative pain control [8], ERAS does not necessarily imply outpatient management. In the perspective of spine surgery, ERAS and outpatient surgery are not equivalent. While the outpatient management focuses on surgical treatment and the measures provided to facilitate the early discharge [7, 8, 10, 13], ERAS in spine surgery includes measures concerning the preoperative, intraoperative, and postoperative periods [2], and same-day discharge is not mandatory. However, even though outpatient surgery is not the goal with ERAS, overall costs and length of stay have been shown to be reduced [15]. Moreover, ERAS in spine surgery is not limited to degenerative pathology, as it is already implemented in oncological spine cases [11], obviously not candidates for outpatient management.

Future challenges

Initial reports regarding the implementation of ERAS in spine surgery are encouraging [6–8, 11–13]. However, our results show that most neurosurgeons, particularly spine neurosurgeons, do not practice ERAS in their daily clinical practice. One reason for that might be the complexity of spine patients, in terms of chronic pain management, functional disability, and psychological consequences of the disease [16, 17]. In this perspective, spine patients are surely different from patients for which ERAS was initially designed. In parallel, financial issues are another barrier to the democratization of ERAS, as reimbursement policies might actually discourage hospitals and surgeons to accelerate the discharge of the patient as well as to multiplicate postoperative ambulatory management, even though outpatient surgery is not considered. Furthermore, there might be an intercountry variability about ERAS implementation, because in countries where DRG

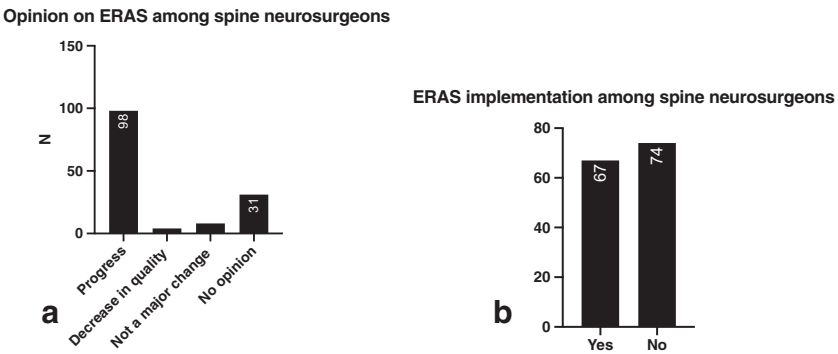

Fig. 2 Opinion on Enhanced Recovery After Surgery in spine among spine neurosurgeons (a) and implementation of the concept in their daily clinical practice (b). ERAS, Enhanced Recovery After Surgery

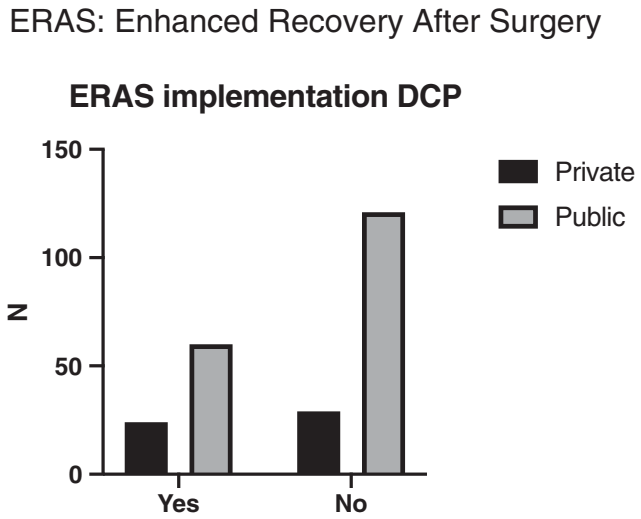

Fig. 3 Enhanced Recovery After Spine Surgery in private and public institutions. ERAS, Enhanced Recovery After Surgery; DCP, daily clinical practice

(diagnosis-related group) reimbursement is applied, an earlier patient's discharge might be associated with a lesser reimbursement from insurances and, by consequences, lesser incomes for the hospitals.

To overcome these barriers, neurosurgeons—and spine neurosurgeons in particular—need to be actively involved in the elaboration of new pathways adapted to spine patients, particularly those with chronic, refractory back pain. Moreover, it is our duty to consider financial costs and promote ERAS to local and national authorities.

Strengths and limitations

This is the first survey on ERAS brought to a large spectrum of neurosurgeons and spine neurosurgeons across Europe. Responses were collected to a secured platform and statistical analysis was performed independently. We included surgeons working in countries with different health systems and health policies, which is a major asset for the study, as it brings various perspectives into the field.

Unfortunately, the results on ERAS implementation obtained from the overall cohort may be biased by the design of the study, as we asked a specific opinion on ERAS in spine surgery; response from non-spine neurosurgeons might lower the results in term of ERAS implementation. A large proportion of the overall cohort had no opinion on ERAS in spine surgery, probably because surgeons felt not concerned.

Conclusion

Despite being promoted among neurosurgeons and, more specifically, spine neurosurgeons, the ERAS concept is not as widely implemented in clinical practices so far, as it is the case in other surgical specialties. Efforts should be made to promote a minimally invasive pre-, intra-, and postoperative workflow to eventually improve patient management and reduce complications and side effects particularly adapted to the spinal surgery. To do so, the particularity of spine patients, in terms of chronic pain, challenging pre- and postoperative pain management, and secondary psychological issues have to be considered.

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Acquisition of data: MVC
Statistical analysis: MVC
Drafting and revision of the article: All authors

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval The manuscript does not contain clinical studies or patient data.

Informed consent Informed consent was not relevant for this study.

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