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Differences in the Practice of Traumatic Spinal Cord Injury Management Among Spine Surgeons in Saudi Arabia

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ABSTRACT

Background: This study aims to explore the ease of adopting clinical practice guidelines (CPGs) in managing traumatic spinal cord injury (TSCI) among spine surgeons, with particular focus on the use of steroids, high-dependency unit, early spinal cord decompression, and maintaining a target mean arterial blood pressure (MAP).

Methods: We conducted a cross-sectional study among the practicing spinal surgeons in Saudi Arabia and included surgeons from neurosurgical and orthopedic backgrounds. The study period was from April to June 2020. The respondents provided sociodemographic data, training background, years of experience, and their clinical practices in managing TSCI via a survey tool constructed based on a literature review. The data were analyzed to evaluate the association between a surgeon's demographics and clinical practices.

Results: Ninety-eight spinal surgeons responded, comprising 40% of the practicing spine surgeon population in Saudi Arabia. The only area where the neurosurgical spine and orthopedic spine surgeons' practices differed significantly was maintaining MAP within a target range. Other differences between practices were not statistically significant. The authors also found a significant correlation between the surgeon's school of training and their experience concerning steroids administration. On the other hand, the surgeon experience and volume of treated TSCI cases correlated significantly with admission to a high-dependency unit.

Conclusions: The adoption of CPGs remains a challenge to many spinal surgeons. Neurosurgeons are more into keeping the MAP at certain target, whereas the school of training and surgeon experience were the largest determinants of the surgeon's practice in managing TSCI in Saudi Arabia.

Clinical Relevance: As the variability in managment among spine surgeons remains a challenge, international and national spine societies are expected to build clinical practice guidelines from the limited existing literature.

Level of Evidence: 3.

Other and Special Categories

Keywords: CPG, traumatic spinal cord injury, spine surgery

INTRODUCTION

Spinal cord injury (SCI) usually occurs due to trauma that causes contusions, partial tear, or transection of the spinal cord.[1] SCI is a frequent cause of long-term consequences and death. Demographic analysis has shown that Saudi Arabia has a high prevalence of SCI of 63 per million cases per year, which exceeds that of many other countries worldwide. Additionally, 81% of SCIs were due to road traffic injuries in Saudi Arabia, which surpassed all previously documented estimates.[2]

In several body systems, SCI can cause permanent dysfunction and, together with a significant shift in performance, contribute to greater morbidity and inferior quality of life.[3] Owing to increased awareness about SCI's pathogenesis, modern diagnostic techniques, and therapeutic methods, acute SCI care has improved dramatically in recent years. Both the acute physical symptoms of trauma and subsequent pathological changes affect the spinal cord. The trauma can be exacerbated within the initial hours following an injury, particularly by ischemia and edema.[4] It is crucial to understand associated risks during the acute stage because they can be life-threatening and contribute to an extended recovery.

As a result of the growing understanding of trauma causes, illness pathogenesis, and the function of surgery, the treatment of patients with traumatic SCI (TSCI) has changed dramatically over the past century. However, numerous controversies surround TSCI care techniques, such as the use of corticosteroids like methylprednisolone sodium succinate and the effective timing of surgical spinal cord decompression. Attempts to improve the care of TSCI patients through CPG have

been implemented but met with variation in adopting these guidelines.

After a thorough literature search, we found no previous study that has explored the adoption of clinical practice guidelines (CPGs) and the factors associated with differences in the clinical practice of TSCI management among spine surgeons from Saudi Arabia or the nearby region. Therefore, this study aims to explore the variation of practice among spine surgeons in the care of TSCI and examine the factors associated with such variability.

METHODS

We conducted a descriptive cross-sectional study targeting all spinal surgeons in Saudi Arabia. An automated prestructured questionnaire was sent directly to every spine surgeon (neurological or orthopedic surgeon) in Saudi Arabia ($N = 240$) via social media channels. The study period was from April to June 2020. The questionnaire was constructed based on extensive literature analysis of the current protocols on the management of TSCI and validated by 5 expert panelists. The questionnaire contained 2 sets of questions. The first set covered the surgeons' sociodemographic data, including specialty (neurosurgery vs orthopedics background), spine school of training, spine fellowship, years of spine practice, type of practice, and the volume of TSCI managed annually.[5,6] The second set of questions covered the surgeons' practices related to TSCI management, including steroid use, high-dependency unit utilization, target mean arterial blood pressure (MAP), and early spinal cord decompression.

Data Analysis

The data were revamped, coded, and entered into IBM SPSS Statistics for Windows, version 22.0 (IBM Corp; Armonk, NY) after collection. Using 2-tailed tests, all quantitative analyses were performed. A P value below 0.05 was considered statistically significant. A descriptive study was conducted based on the frequency and percentage distribution for all factors, including demographic data and spinal surgery experience. Cross-tabulation was used to assess univariate analysis for the association between surgeons' demographic data and their clinical practices regarding spinal surgeries. Relationships were checked using an exact probability measure due to small data frequencies.

Table 1. Demographics of participating spine surgeons in Saudi Arabia ($N = 98$).

Personal Data	*n*	%
Specialty		
Neurosurgery	60	61.2%
Orthopedics	38	38.8%
School of training		
European	21	21.4%
Local	21	21.4%
North American	56	57.1%
Dedicated spine fellowship		
Yes	53	54.1%
No	45	45.9%
Time in practice, y		
<5 y	23	23.5%
5–10 y	20	20.4%
>10 y	55	56.1%
Where do you practice currently?		
MOH government hospital	41	41.8%
MOH private hospital	40	40.8%
National guard hospital	15	15.3%
University hospital	16	16.3%
Military hospital	11	11.2%
King Faisal Specialist Hospital & Research Center	5	5.1%[a]
Annual number of acute spinal cord injury cases you manage		
<10	50	51.0%
10–20	23	23.5%
>20	25	25.5%

Abbreviation: MOH, Ministry of Health.
[a]Some surgeons work in more than 1 hospital.

RESULTS

The study included 98 respondents from Saudi Arabia, of whom 60 (61.2%) were neurosurgeons and 38 (38.8%) were orthopedic surgeons. Regarding training, 56 (57.1%) were from North American schools, and 21 (21.4%) had either attended European or local schools. Fifty-three (54.1%) surgeons had a dedicated spine fellowship, while 55 (56.1%) had practiced spine surgery for 10 years or more. Regarding practice setting, 41 (41.8%) worked at the Ministry of Health hospitals, 40 (40.8%) in private hospitals, 16 (16.3%) in university hospitals, and 15 (15.3%) at the national guard hospital. As for the number of cases of acute SCI they manage per year, 50 (51%) reported handling fewer than 10 cases while 25 (25.5%) reported more than 20 cases per year (Table 1).

Table 2 presents the distribution of surgeons' practice regarding SCI by their specialty. Steroids were never administered to patients by 43.9% of respondents, while 23.5% reported administering steroids only if the injury occurred within the past 8 hours, and 21.4% administered steroids if the damage occurred within the past 24 hours. Among respondents, 45% of neurosurgeons never administered steroids, while 42.1% of orthopedic surgeons ($P = 0.506$) never administered steroids. Also, concerning the duration of keeping

Table 2. Spine surgeon traumatic spinal cord injury–related practice differences based on specialty.

Practice Regarding Spinal Cord Injuries	Total (%)	Specialty				*P* Value
		Neurosurgery		Orthopedics		
		n	%	*n*	%	
Use of steroid						0.506
I never give steroids	43 (43.9%)	27	45.0%	16	42.1%	
I give if injury is less than 8 h	23 (23.5%)	13	21.7%	10	26.3%	
I give if injury is less than 24 h	21 (21.4%)	15	25.0%	6	15.8%	
I give regardless of time of the injury	11 (11.2%)	5	8.3%	6	15.8%	
Duration of steroid treatment						0.422
1 dose	7 (12.7%)	3	9.1%	4	18.2%	
Up to 12 h	1 (1.8%)	0	0.0%	1	4.5%	
Up to 24 h	24 (43.6%)	16	48.5%	8	36.4%	
Up to 48 h	23 (41.8%)	14	42.4%	9	40.9%	
Steroid drug used						0.500
Dexamethasone	22 (40%)	12	36.4%	10	45.5%	
Methylprednisolone sodium succinate	33 (60%)	21	63.6%	12	54.5%	
Admission to high-dependency unit						0.417
All cases	34 (34.7%)	23	38.3%	11	28.9%	
Only cervical cord injury	40 (40.8%)	24	40.0%	16	42.1%	
Depends on availability of beds	16 (16.3%)	10	16.7%	6	15.8%	
None	8 (8.2%)	3	5.0%	5	13.2%	
Maintenance of the mean arterial pressure in a certain range						0.029[a]
Yes	78 (79.6%)	52	86.7%	26	68.4%	
No	20 (20.4%)	8	13.3%	12	31.6%	
Early spinal cord decompression						0.349
I always do decompression in less than 24 h of the injury	58 (59.2%)	33	55.0%	25	65.8%	
I believe in early decompression, but the facility does not allow this practice	16 (16.3%)	13	21.7%	3	7.9%	
Whenever operating room time is available	15 (15.3%)	9	15.0%	6	15.8%	
I don't believe that early decompression adds a neurological benefit	9 (9.2%)	5	8.3%	4	10.5%	

[a]$P < 0.05$ (significant).

patients on steroids, 24 (43.6%) surgeons who gave steroids reported that they administered them for up to 24 hours, and 23 (41.8%) administered them for up to 48 hours. Also, 48.5% of the neurosurgeons gave steroids for up to 24 hours compared with 36.4% of orthopedic surgeons who did the same, and giving steroids for up to 48 hours was reported among 42.4% of neurosurgeons and 40.9% of orthopedic surgeons. These differences were found to be statistically insignificant ($P = 0.422$). Methylprednisolone sodium succinate was the most given steroid (60%), issued by 63.6% of the neurosurgeons and 54.5% of the orthopedic surgeons ($P = 0.500$). Regarding admission of SCI patients in high-dependency units, 34 surgeons (34.7%) reported that they isolate all of them, and 40 (40.8%) surgeons said that they isolate only cervical cord injury cases. In contrast, 16 (156.3%) said their decision depends on the availability of beds. Moreover, 38.3% of the neurosurgeons and 28.9% of the orthopedic surgeons isolated the cases ($P = 0.417$). Seventy-eight (79.6%) surgeons kept the MAP in a particular range, reported by 86.7% of neurosurgeons and 68.4% of orthopedic surgeons with historical statistical significance ($P = 0.029$). As for early decompression, 58 (59.2%) surgeons reported that they always do decompression within 24 hours of the injury, while 9 (9.2%) do not think early decompression adds neurological benefit. Early decompression was reported by 55% of neurosurgeons and 65.8% of orthopedic surgeons ($P = 0.349$).

Table 3 presents the distribution of surgeons' practices regarding SCI by their school of training. Among respondents, 50% of the surgeons who attended North American schools never gave steroids; the same was noted with 28.6% of the surgeons who attended local schools, with a significant difference ($P = 0.049$). Keeping the MAP in a particular range was reported by 85.7% of the surgeons who attended local schools and 61.9% of those who attended European schools ($P = 0.044$). All other practices were insignificantly different among surgeons who attended other schools.

Table 4 shows the distribution of surgeons' practices regarding SCI by their spine fellowship. Never giving steroids for cases was reported by 54.7% of surgeons who had a dedicated spine fellowship compared with 31.3% of those who did not ($P = 0.098$). Admitting SCI patients in high-dependency units was reported by 39.6% of surgeons who had a spine fellowship compared with 28.9% of those who did not ($P = 0.308$). Keeping the MAP in a particular range was reported by 81.1% of surgeons who had a spine

Table 3. Spine surgeon traumatic spinal cord injury practice differences based on school of training.

	School of Training						
	Local		European		North American		
Practice Regarding Spinal Cord Injuries	***n***	**%**	***n***	**%**	***n***	**%**	***P* Value**
Your practice regarding giving steroids in acute spinal cord–injured patient							0.049[a]
I never give steroids	6	28.6%	9	42.9%	28	50.0%	
I give if injury is less than 8 h	6	28.6%	3	14.3%	14	25.0%	
I give if injury is less than 24 h	8	38.1%	5	23.8%	8	14.3%	
I give regardless of time of the injury	1	4.8%	4	19.0%	6	10.7%	
If you give steroids, how long do you keep the patient on it?							0.834
1 dose	1	6.7%	2	16.7%	4	14.3%	
Up to 12 h	0	0.0%	0	0.0%	1	3.6%	
Up to 24 h	8	53.3%	6	50.0%	10	35.7%	
Up to 48 h	6	40.0%	4	33.3%	13	46.4%	
Steroid medication administered							0.676
Dexamethasone	5	33.3%	6	50.0%	11	39.3%	
Methylprednisolone sodium succinate	10	66.7%	6	50.0%	17	60.7%	
Do you admit isolated spinal cord injury patients in the high-dependency unit?							0.307
Yes, all of them	5	23.8%	4	19.0%	25	44.6%	
Only cervical cord injury	10	47.6%	12	57.1%	18	32.1%	
Depends on availability of beds	4	19.0%	4	19.0%	8	14.3%	
None of them	2	9.5%	1	4.8%	5	8.9%	
Do you aim to keep the mean arterial pressure in a certain range?							0.044[a]
Yes	18	85.7%	13	61.9%	47	83.9%	
No	3	14.3%	8	38.1%	9	16.1%	
Do you try to do early decompression?							0.427
I always do decompression in less than 24 h of the injury	11	52.4%	11	52.4%	36	64.3%	
I believe in early decompression, but the facility does not allow this practice	6	28.6%	2	9.5%	8	14.3%	
Whenever operating room time is available	2	9.5%	5	23.8%	8	14.3%	
I don't believe early decompression adds neurological benefit	2	9.5%	3	14.3%	4	7.1%	

[a]$P < 0.05$ (significant).

Table 4. Spine surgeon traumatic spinal cord injury practice differences based on spine fellowship.

	Dedicated Spine Fellowship				
	Yes		No		
Practice Regarding Spinal Cord Injuries	***n***	**%**	***n***	**%**	***P* Value**
Your practice regarding giving steroids in acute spinal cord–injured patient					0.098
I never give steroids	29	54.7%	14	31.1%	
I give if injury is less than 8 h	10	18.9%	13	28.9%	
I give if injury is less than 24 h	8	15.1%	13	28.9%	
I give regardless of time of the injury	6	11.3%	5	11.1%	
If you give steroids, how long you keep patient on it?					0.390
1 dose	3	12.5%	4	12.9%	
Up to 12 h	1	4.2%	0	0.0%	
Up to 24 h	8	33.3%	16	51.6%	
Up to 48 h	12	50.0%	11	35.5%	
Steroid medication administered					0.824
Dexamethasone	10	41.7%	12	38.7%	
Methylprednisolone sodium succinate	14	58.3%	19	61.3%	
Do you admit isolated spinal cord injury patients in high-dependency unit?					0.308
Yes, all of them	21	39.6%	13	28.9%	
Only cervical cord injury	19	35.8%	21	46.7%	
Depends on availability of beds	7	13.2%	9	20.0%	
None of them	6	11.3%	2	4.4%	
Do you aim to keep the mean arterial pressure in a certain range?					0.681
Yes	43	81.1%	35	77.8%	
No	10	18.9%	10	22.2%	
Do you try to do early decompression?					0.478
I always do decompression in less than 24 h of the injury	31	58.5%	27	60.0%	
I believe in early decompression, but the facility does not allow this practice	8	15.1%	8	17.8%	
Whenever operating room time is available	7	13.2%	8	17.8%	
I don't believe early decompression adds neurological benefit	7	13.2%	2	4.4%	

Table 5. Spine surgeon traumatic spinal cord injury practice differences based on years of practice.

	Years You Have Been in Practice						
	<5 y		5–10 y		>10 y		
Practice Regarding Spinal Cord Injuries	***n***	**%**	***n***	**%**	***n***	**%**	***P* Value**
Your practice regarding giving STEROIDS in acute spinal cord–injured patient							0.657
I never give steroids	12	52.2%	7	35.0%	24	43.6%	
I give if injury is less than 8 h	5	21.7%	4	20.0%	14	25.5%	
I give if injury is less than 24 h	3	13.0%	5	25.0%	13	23.6%	
I give regardless of time of injury	3	13.0%	4	20.0%	4	7.3%	
If you give steroids, how long you keep patient on it?							0.011[a]
1 dose	0	0.0%	1	7.7%	6	19.4%	
Up to 12 h	1	9.1%	0	0.0%	0	0.0%	
Up to 24 h	3	27.3%	3	23.1%	18	58.1%	
Up to 48 h	7	63.6%	9	69.2%	7	22.6%	
Steroid medication administered							0.168
Dexamethasone	6	54.5%	7	53.8%	9	29.0%	
Methylprednisolone sodium succinate	5	45.5%	6	46.2%	22	71.0%	
Do you admit isolated spinal cord injury patients in high-dependency unit?							0.049[a]
Yes, all of them	14	60.9%	7	35.0%	13	23.6%	
Only cervical cord injury	7	30.4%	7	35.0%	26	47.3%	
Depends on availability of beds	2	8.7%	3	15.0%	11	20.0%	
None of them	0	0.0%	3	15.0%	5	9.1%	
Do you aim to keep the mean arterial pressure in a certain range?							0.279
Yes	21	91.3%	15	75.0%	42	76.4%	
No	2	8.7%	5	25.0%	13	23.6%	
Do you try to do early decompression?							0.390
I always do decompression in less than 24 h of the injury	18	78.3%	11	55.0%	29	52.7%	
I believe in early decompression, but the facility does not allow this practice	2	8.7%	3	15.0%	11	20.0%	
Whenever operating room time is available	3	13.0%	3	15.0%	9	16.4%	
I don't believe early decompression adds neurological benefit	0	0.0%	3	15.0%	6	10.9%	

[a]$P < 0.05$ (significant).

surgery fellowship compared with 77.8% of those who did not ($P = 0.681$).

Table 5 illustrates the distribution of surgeons' practices regarding SCI by their years of practice. Among respondents, 52.2% of surgeons who practice spinal surgery for fewer than 5 years did not give steroids compared with 35% of those who have practiced for 5 to 10 years with no statistical significance ($P = 0.657$). Regarding the duration of administering the steroid, 69.2% of those who gave steroids did so for up to 48 hours compared with 22.6% of those who have practiced surgery for 10 years or more ($P = 0.011$). Regarding admission of SCI patients in a high-dependency unit, 60.9% of surgeons practicing for fewer than 5 years admit all of their SCI patients to high-dependency units compared with 23.6% of those who have practiced for more than 10 years. None of the surgeons who had low experience admitted isolated SCI to high-dependency unit compared with 15% of those who have practiced for 5 to 10 years ($P = 0.049$).

Table 6 demonstrates the distribution of surgeons' practices regarding SCI by the number of cases of acute SCI they manage per year. Among respondents, 44% of those who performed fewer than 10 surgical procedures per year isolate all patients. Also, 20% of those who performed more than 20 surgical procedures per year isolate all patients compared with 32% of those who perform fewer than 10 surgical procedures per year, and 60.9% of surgeons who perform 10 to 20 surgical procedures per year isolate all patients.

DISCUSSION

Adopting CPGs is a challenging subject that has been thoroughly discussed in the literature. However, despite the vast number of publications, applying these guidelines in daily practice remains hazy.[7]

As with all CPGs, 2 viewpoints are always faced. Some clinicians look at CPGs to improve patient outcomes and reduce the variability in practice, potentially helping clinicians in medicolegal litigations and guiding stakeholders and decision-makers in unifying the management process. This potentially has a significant economic impact.[7,8] The other viewpoint looks to medicine as an art, and maintains that CPGs are supposedly for novice or nonexpert clinicians. CPGs may have a value only in subjects outside the clinician's primary mastery.[9] In this study, the authors evaluated the compliance of spine surgeons in Saudi Arabia to the CPG published in 2017 by *Global Spine Journal* in their

Table 6. Spine surgeon traumatic SCI practice differences based on the number of cases managed per year.

	Number of Cases of Acute SCI You Manage per Year						
	<10		10–20		>20		
Practice Regarding SCIs	**No**	**%**	**No**	**%**	**No**	**%**	***P* Value**
Your practice regarding giving steroids in an acute SCI patient							0.528
I never give steroids	20	40.0%	9	39.1%	14	56.0%	
I give if injury is less than 8 h	12	24.0%	5	21.7%	6	24.0%	
I give if injury is less than 24 h	11	22.0%	5	21.7%	5	20.0%	
I give regardless of time of the injury	7	14.0%	4	17.4%	0	0.0%	
If you give steroids, how long do you keep the patient on it?							0.191
1 dose	6	20.0%	1	7.1%	0	0.0%	
Up to 12 h	0	0.0%	1	7.1%	0	0.0%	
Up to 24 h	13	43.3%	4	28.6%	7	63.6%	
Up to 48 h	11	36.7%	8	57.1%	4	36.4%	
Steroid medication administered							0.628
Dexamethasone	13	43.3%	6	42.9%	3	27.3%	
Methylprednisolone sodium succinate	17	56.7%	8	57.1%	8	72.7%	
Do you admit isolated SCI patients in high-dependency unit?							0.029[a]
Yes, all of them	22	44.0%	7	30.4%	5	20.0%	
Only cervical cord injury	16	32.0%	14	60.9%	10	40.0%	
Depends on availability of beds	6	12.0%	2	8.7%	8	32.0%	
None of them	6	12.0%	0	0.0%	2	8.0%	
Do you aim to keep the mean arterial pressure in a certain range?							0.550
Yes	41	82.0%	19	82.6%	18	72.0%	
No	9	18.0%	4	17.4%	7	28.0%	
Do you try to do early decompression?							0.324
I always do decompression in less than 24 h of the injury	32	64.0%	15	65.2%	11	44.0%	
I believe in early decompression, but the facility does not allow this practice	6	12.0%	3	13.0%	7	28.0%	
Whenever operating room time is available	6	12.0%	3	13.0%	6	24.0%	
I don't believe early decompression adds neurological benefit	6	12.0%	2	8.7%	1	4.0%	

Abbreviation: SCI, spinal cord injury;
[a]$P < 0.05$ (significant).

special issue titled "Clinical Practice Guidelines for the Management of Degenerative Cervical Myelopathy and Traumatic Spinal Cord Injury."

Since 1990, many randomized controlled studies have investigated the effects of corticosteroids in acute SCI patients, with confusing evidence on their impact on neurological outcomes in SCI patients.[10] In an extensive systematic review, Fehling et al concluded that a 24-hour steroid regimen has no impact in the long run; however, when given within 8 hours of injury, steroids tend to benefit the long-term recovery in motor function. This conclusion was adopted in the CPGs of the Global Spine and Arbeitsgemeinschaft für Osteosynthesefragen Foundation.[11,12]

Another systematic review examined 12 studies, 5 of which were randomized controlled trials and 7 of which were observational studies. The authors found that the use of methylprednisolone therapy within the first 8 hours after the injury did not show any statistically significant change in neurological recovery, either in the short or long term. However, methylprednisolone therapy was linked to an increased risk of pneumonia and hyperglycemia relative to the controls.[12]

A recent review concluded that, except for the National Acute SCI Study 2 trial results, most studies found that steroids did not offer any short- or long-term benefits.[13] The variation in steroid administration duration across the spectrum of studies might be the cause of the inconsistent findings. However, 2 other systematic reviews found a lack of positive steroid impact on SCI patients, a finding that may be due to the inclusion of patients with spine gunshot injuries and pediatric patients.[12,14,15]

Methylprednisolone is the drug evaluated in most SCI studies; no randomized controlled trials investigated the use of other steroids in SCI patients, such as dexamethasone. Despite the lack of well-structured clinical studies in assessing dexamethasone in SCI patients, preclinical studies have demonstrated some neurological benefits.[16,17]

This contradicting evidence is demonstrated in our study, where the respondents have diverse and varying

views regarding the use of steroids in their daily practices. There were no statistical differences except for surgeons with a North American schooling background who tend to provide steroids in SCI patients within 8 hours of injury. There is also no consistency in steroid type among spine surgeons who give SCI patients steroids. Regarding factors such as the influence of years in practice, the number of patients treated annually, dedicated spine fellowship, and neurosurgery vs orthopedic specialty background, none of them impacted the decision to give steroids in SCI patients or the type of steroids.

Secondary injury avoidance by preventing hypotension is a well-accepted fact among spine surgeons. However, the idea of continuous monitoring of blood pressure in acute SCI patients remains controversial. This management idea started early in 1991 with a case series by Wolf et al with 52 patients and an MAP above 85 mm Hg. They continued their protocol for 5 days, followed patients for 1 year, and reported a stable or improved neurological function in their series.[17–19]

Three decades later, Saadeh et al, in their 2017 review, found only 11 studies to address this management strategy: 9 were retrospective and 2 were prospective, and only 1 had a comparative arm. Saadeh et al concluded that, despite the lack of high-quality studies, the target MAP of 85 to 90 mm Hg for 5 to 7 days should be considered in acute SCI patients. Achieving such a goal is possible in either an intensive care unit setting or high-dependency unit.[19,20]

In this specific management, we found statistically significant differences where spine surgeons with neurosurgery backgrounds tended to keep target MAP ranges in their management plan, as did spine surgeons with local or North American training (vs training at European schools). However, none of the other factors impacted MAP management (eg, the influence of years in practice, number of patients treated annually, and dedicated spine fellowship).

The impact of the timing of decompression surgery after SCI is gaining more attention. Over the past decade, several studies have looked into the effects of early decompression on neurological development.[21,22] The Surgical Timing in Acute Spinal Cord Injury Study in 2012 was one of the first prospective cohort studies that shed light on early decompression surgery in acute SCI, and the study concluded that if decompression is carried out within 24 hours after the injury, patients tend to have a better neurological outcome relative to the control group. The study defined recovery of the neurological development as at least a 2-grade improvement in the American Spinal Injury Association Impairment Scale at 6-month follow-up.[23]

A meta-analysis of 7 studies, in which 4 were prospective cohort studies and 3 were retrospective studies, found that early surgical decompression within the first 8 hours after the injury was beneficial in the surgical recovery compared with late surgeries (ie, those occurring more than 8 hours after the injury).[23] The authors noticed many limitations in the analysis, like the differences among studies in defining the term "early decompression," where they found a range from 4 to 96 hours. However, more studies have limited this term to the first 24 hours after the injury. Also, some studies used steroids, and whether that had any impact on the outcome of being a confounding factor remains unknown.[24]

The same authors of the meta-analysis published their own institutional experience, which confirmed the same outcome of improvement in neurological status when surgery was performed within 8 hours of injury; however, as expected, incomplete SCI patients had better neurological recovery than complete SCI patients.[25]

On the other hand, some studies examined the impact of delay in surgery on length of hospital stay and suggested that, regardless of the improvement in neurological status, patients are expected to benefit from early surgery regardless—for early mobilization and initiation of rehabilitation programs—eventually reducing the economic burden on the health care system.[26]

However, an extensive Japanese nation-wide study on 514 SCI patients defined early surgery as within 24 hours of injury and late surgery from 25 hours to 7 days from the event of injury, and the authors found no impact from early surgery on intensive care unit stay for in-hospital mortality.[27]

An "old fear" common among spine surgeons is that early intervention may be associated with worse outcomes, and this remains a legitimate concern, causing surgeons to prefer to wait longer before surgical treatment, especially in cervical spine injuries.[27]

Limitations

Our study only saw a 40% response from those surveyed, which may not give the complete picture of the current practice in Saudi Arabia. However, statisticians consider this a reasonable response rate. Also, the questionnaire did not assess surgeon's outcomes based on their practice for 2 reasons. First, we wanted to eliminate potential recall bias, and second, we wanted to keep the questionnaire to a reasonable length to encourage greater engagement among respondents. We

acknowledge the limitations of questionnaire-based studies in general; however, a questionnaire-based study was chosen due to the lack of national registry. In addition, the questionnaire did not address the change of practice if surgeon moved from one institution to another. Also, the questionnaire did not include questions on performing magnetic resonance imaging and whether that influences timing or surgery. Furthermore, the fact that 51% of responders had a low volume of cases and the 56% of responding surgeons had more than 10 years in practice is a potential for bias in the study, which may influence results.

One more limitation is the fact that we didn't consider the level of SCI or the diagnosis of neurogenic shock. These are potentially confounding factors in such studies since monitoring of the MAP is taken as a parameter. We did not include them to reduce the recall bias by surgeons and because it is a questionnaire-based study rather than a database study.

CONCLUSIONS

The practice among spine surgeons in Saudi Arabia was only mildly affected by the surgeon's specialty, school of training, and experience. Use of steroids, early decompressive surgery, high-dependency care unit, and maintenance of a target range of MAP were the areas of practice differences. With the numerous gray areas in spinal surgery, the adoption of CPGs remains a considerable challenge.

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