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ORIGINAL STUDY

Management of spinal trauma patients: a national survey in The Netherlands

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Lack of consensus in spinal trauma management and differences in the practical organization between trauma regions can have significant consequences on the fate of patients with spine trauma. For this reason a national survey was conducted among the 11 trauma regions in the Netherlands. Representative surgeons were sent a survery on seven areas of spinal trauma management: treatment protocol, (2) referral, (3) advisory committee, (4) classification used, (5) responsible medical specialist, (6) timing of surgical intervention, and (7) the current view on spinal trauma care. All 11 centers completed the survey yielding a response rate of 100%. The results of this study shows that in a relative small country, all seven areas in the management of spine trauma differs substantially and can be of use to show the possible areas of discrepancies between trauma centers in comparable European countries.

Keywords : management ; spinal trauma ; survey ; the Netherlands.

INTRODUCTION

Spinal trauma with or without spinal cord injury (SCI) may lead to significant disability with poor functional outcomes.7 Motor vehicle accidents, falls, violence, and sports are the leading causes of spinal injuries *(3,20)*. Associated neurologic damage is a cause of lasting and serious disability. A worldwide SCI incidence ranging from 10.4 to 83 per million inhabitants per year has been reported in which males are disproportionately affected with a male-female ratio of 4:1 and a mean age of 33 years *(3,23)*. The Netherlands is one of the enlisted countries with the lowest reported incidence of a mere 10.4 per million inhabitants per year *(2,23)*. Despite these relatively low rates, SCI has not only been associated with a negative impact on the lives of sufferers, but also with extremely high economic costs *(21)*.

Most of the thoracolumbar spinal fractures without neurologic involvement are treated non-operatively with favorable long-term outcomes *(15)*. In recent literature, reviewing operative versus non-operative treatment in thoracic and lumbar fractures, no definite conclusions could be drawn with regards to complication rates and long-term outcome between the two methods *(8,10)*. The common treatment of SCI is surgical stabilization followed by rehabilitation and complication prevention *(19)*. However, SCI remains a heterogeneous group of injuries and therefore various treatments can be

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associated with good clinical outcomes. On top of that it has to be noted that not every hospital has the proper facilities to give optimal care to trauma patients with SCI and therefore specific criteria are mentioned in SCI guidelines to determine whether patients should be transported to a specialized trauma center *(17)*. However, the choice of optimal treatment remains difficult to determine due to the limited number of high-quality studies and the multiple clinical variables that accompany spinal trauma (e.g. the degree of ligamentous and bone injury, the presence of neurologic deficits, associated other traumatic lesions and overall health status).

Throughout the literature several conservative and surgical procedures have been mentioned and proposed, and numerous studies on the management of traumatic SCI have been conducted. However, to date, there is lack of consensus in treatment with regard to fracture and neurologic deficit, classification, scoring system, the decision to operate, ideal timing for surgery, and surgical approaches *(1,9,13,16)*. Organization of trauma care in a country or region can have significant consequences on the fate of patients with spinal column injuries. In the Netherlands, the Ministry of Health appointed in 1997, 11 trauma centers, each responsible for emergency health care in their region. The goal is to create intensive collaboration between different hospitals in a trauma region, as with Medical Mobile Teams and Ambulances. Trauma protocols are synchronized between these regional hospitals and there is a regional registration of trauma patients. Another initiative in optimizing Spinal Care comes from the Spinal Cord Injury Organization Netherlands (DON). This patients' organization with 1300 members was founded in 1976. They presented a health care report in 2013 on Spinal Cord Injury with the intention to investigate the complete pathway of healthcare from patients' perspective. The report was supported by the Dutch-Flemish Spinal Cord Injury Society, the Dutch Spine Society, The National Society Acute Health Care and the Dutch Society of Neurology *(24)*.

Despite these guidelines from professionals' and patients' perspectives the practical organization and management of spinal trauma patients and differences between trauma regions are largely unknown. We conducted a survey among the trauma regions for the purpose of clarification of these differences.

MATERIALS AND METHOD

We approached all 11 trauma centers and asked them to appoint a representative surgeon involved in the acute care of spinal trauma patients in their regions. All centers received an invitation to participate in the study. A repeat email was sent to non-responders after 4, 6 and 8 weeks. After 12 weeks, physicians were contacted by phone. No financial compensation was granted to participants.

The survery consisted of 9 multiple choice questions and 7 open questions on seven areas of spinal trauma management: (1) treatment protocol, (2) referral, (3) advisory committee, (4) classification used, (5) responsible medical specialist in spinal trauma care, (6) timing of surgical intervention, and (7) the current view of health care professionals involved in the management of spinal trauma patients.

Data was collected from September 2013 to December 2014. All responses were manually recorded and analysed with Microsoft Excel 2011.

RESULTS

All the 11 centers completed the survey yielding a response rate of 100%. Trauma centers were represented by a neurosurgeon, orthopaedic surgeon or general trauma surgeon. Eight of the 11 trauma centers have protocol on the care, transfer, and treatment of patients with spine trauma in the region. Table I provides inisght in the treatment protocols of the 11 trauma centers regarding spinal injury.

All 11 trauma centres have an advisory board regarding spinal trauma patients (Table II). This advisory board sets the policy for patients with traumatic spinal injury and consists of a board of medical doctors with various background specialities. Neurosurgeons were present in all trauma centres' advisory boards. Orthopaedic surgeons in 10 out of 11. Varying between trauma centres, trauma surgeons, general surgeons and

Table I. — Questions on spinal trauma treatment protocols

Questions	Yes	No	Partly
Is there a protocol on the care, transfer, and treatment of patients with spine trauma in the region?	8	2	1
Is the trauma center in the region the same as the neurosurgery center?	11	0	0
Are all patients with suspected neurological deficit transferred to a trauma center in the region?	11	0	0

Table II. — Presence of an advisory board regarding spine trauma

Question	Yes	No
Is there a specific advisory board of spinal trauma patients in the trauma center?	11	0

rehabilitation physicians supported neurosurgeons and orthopaedic surgeons. In some cases a neurologist, intensive-care physician, or a radiologist constituted support (Figure 1).

In nine of the 11 trauma centers both neurosurgeons and orthopaedic surgeon are together responsible for surgical treatment, spinal surgery, cervical or thoracolumbar. In the other 2 centers both trauma general surgeons and orthopaedic surgeons operate on thoracolumbar spinal fractures. In these 2 centers neurosurgeons are responsible for operative procedures of the cervical spine, with or without neurological deficit (Figure 2).

Patients suffering from neurological deficit due to spinal trauma are transported to a trauma center or a hospital specialized in this type of injury. A ratio of 1:1.6 was found when comparing available hospitals in the regions of the trauma centeres for spinal trauma with neurological deficit versus without neurological deficit, respectively (Table III).

In cervical spine fractures the SLIC, AO and AO revised classifications are used. Five trauma centers did not use a classification system in the assessment of patients with cervical spinal fractures. The assessment of patients with thoracolumbar

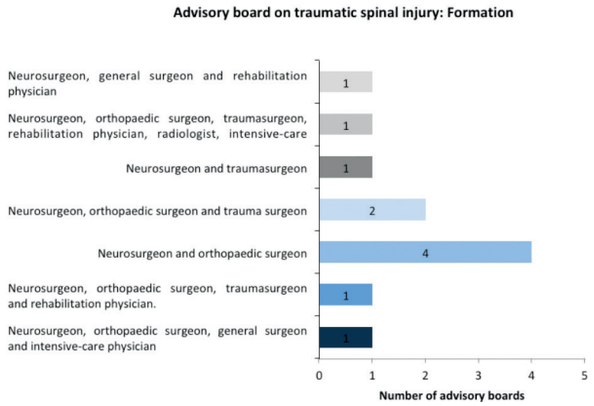

Fig. 1. — Advisory board on traumatic spinal injury

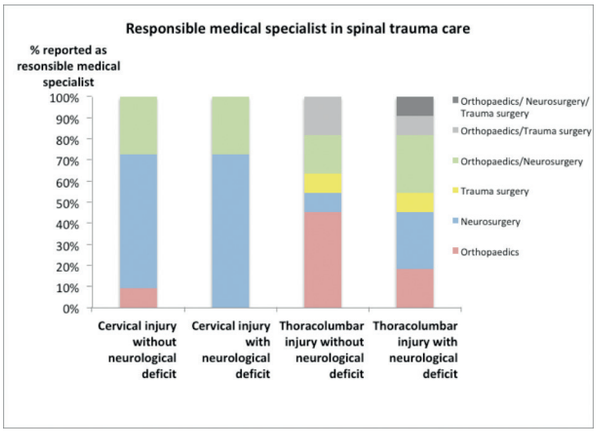

Fig. 2. — Responsible medical specialist in spinal trauma care

Table III. — Questions on the management of spinal trauma patients with and without neurological deficit.

Questions	Total N of hospitals
How many hospitals are eligble to treat patients with spinal fracture without neurological impairment?	28
How many hospitals are eligble to treat patients with spinal fracture with neurological impairment	17

fracture varies from AO, AO revised, and TLICS, classification. Five trauma centers use a combination of the classification systems, 3 use the AO-Magerl classification, 2 use the AOSpine revised (this was just published during data gathering), and 1 uses the TLICS classification.

The classification system for neurological deficit due to spinal trauma is more straightforward than

the classification for spinal fractures. Of the 11 trauma centres, 6 use the American Spinal Injury Association classification (ASIA), 3 use Frankel and 2 reported to use both classification systems (Table IV).

Table IV. — Classification of spinal injuries

Spinal injury	Classification			
Cervical fractures	SLIC	AO	AO Revised	None
	2	2	2	5
Thoracolumbar fracture	TLICS	AO	AO Revised	Combination
	1	3	2	5
Neurological impairment	ASIA	Frankel	Combination	
	6	3	2	

In patients with incomplete neurological deficit: 6 trauma centers operate within 6 hours, 4 trauma centers within 24 hours, and 1 trauma center within 48 hours. Patients suffering from complete neurological deficit after spinal trauma are less likely to be operated within 6 hours (only 3 trauma centers). Trauma centers prefer to wait longer before performing an operation in patients with complete neurological deficit (Figure 3).

All participants were asked to grade spinal trauma management in their region with a score between 0 and 10. This resulted in 5 being the lowest grade awarded and 10 the highest, and an average of 7.7 (range 5-10) points given. Sixty-four

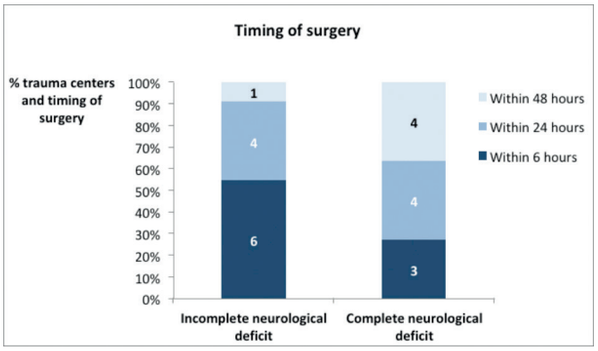

Fig. 3. — Comparison timing of surgery after traumatic spinal injury: incomplete versus complete neurological deficit

percentage of the health care professionals involved in spinal trauma care answered that there is a need for a more concentrated care for patients with spinal trauma (Table V).

Table V.— Questions on the need for concentrated care for patients with spinal trauma

Questions	Yes	No
Is there need for a more concentrated care of patients with spinal injury?	8	2
Is there a co-operation with the rehabilitation of patients with spinal injury in the trauma region?	11	0

Eight participants gave suggestions to improve the management around spinal trauma patients. In short, seven participants of the nationwide health care professionals involved in the management of spinal trauma patients agreed there is need for a more centralized management of spinal trauma. In addition the following suggestions were made:

- There is need for clearer classification and referral guidelines for clinics not specialized in spinal injuries;
- There is need for an improved standardized evaluation when patients with spinal trauma arrive at the emergency room;
- There is need for more collaboration with trauma general surgeons;
- There should be a better transfer of imaging data;
- Investments in a digital communication network are desired;
- Establishing a team unit with surgeons, rehabilitation and intensive-care physicians is suggested;
- All spinal trauma patients should be directed immediately to the level-1 trauma center in the region;
- There should be specific demands for surgical health care professionals involved with this type of injury, and;
- Surgeons should be up to date with the recent developments and scientific research and perform a minimum, sufficient number of spinal operations.

Three participants had no comments or suggestions. However, in one region there is a regional think tank with all spine surgeons that meets biannually. Additionally there is frequent consultation on clinical cases (two to three times a week). This group graded their spinal trauma management with an 8 out of 10.

DISCUSSION

This survey reveals some variations in the initial assessment and treatment among the 11 trauma centers in the Netherlands. Besides large variations in the composition of advisory committees on management of traumatic spinal injury, there are variations in policy concerning classification systems, leading practitioners, and timing of surgical intervention. Ultimately, the survey demonstrates that more concentrated care and better communication is required for the optimal management in patients with traumatic spinal injury.

In the guideline on Acute Traumatic Spinal Injuries they notice the differences between the regional trauma centers but cannot conclude if there is a difference in quality in treatment of patients with spinal cord injury. They advise to make clear arrangements in stabilizing patients, transferring patients, diagnostics and treatment of patients between the hospitals in the specific trauma region. They also advise a more concentrated care of patients with spinal injuries, something the patient federation also agrees on. The United States started with centralizing acute health care for spinal cord injury patients, creating Acute Spinal Cord Injury Units. This Unit is closely attached to the Intensive Care Unit and provides multidisciplinary Health Care and has a minimum of 50 admitted patients a year with spinal cord injury.4 Since there are around 200 patients a year with spinal cord injuries in the Netherlands, the patient federation advises 3-4 hospitals *(2,24)*.

Variation between trauma centers was found with regards to the composition of their advisory committees on traumatic spinal injury (Figure 1). The latest national guidelines indicate that patients with (poly-)trauma, arriving at a trauma center, should receive treatment by a team of medical doctors (with various backgrounds) under supervision of a trauma general surgeon where there should be a trauma protocol for patients with spinal injury *(17)*. The results of our survey demonstrate that this is currently not the case in some trauma centers. One can imagine that due to the low incidence of traumatic spinal injury, and its widespread complex clinical presentation of symptoms, a guideline for the composition of an advisory committee could be beneficial in each trauma center dealing with traumatic spinal injury to obtain a more thoroughly and multidisciplinary approach which also could improve registration of these patients in order to create prospective databases and perform high quality outcome analysis of treatment.

Our data suggests that there is a need for a new classification system regarding cervical spinal trauma with 5 trauma centers in our study not using a specific classification for these fractures. During the writing of this paper the AOspine subaxial cervical spine injury classification system was published following the revised thoracolumbar one. We expect that this newly designed AO Spine subaxial cervical classification system will be a valuable tool for communication, patient care, and research purposes *(22)*. In addition, we believe the new classification system to improve the communication and multidisciplinary approach of cervical traumatic spinal injury. Concerning thoracolumbar classification schemes there is more consensus, although still 4 different systems are used. There are pro's and con's for each system but patient care could benefit of 1 universally accepted classification system. For this the AO revised classification of traumatic thoracolumbar injuries could be used published in 2013, although it should still be evaluated after 1-2 year usage, as planned *(18)*.

Another variation is seen in the background of the surgeons involved in the treatment of traumatic spinal injury (Figure 2). In the Netherlands there is an ongoing discussion about the acknowledgement of spinal surgery operations and surgeons that perform these operations. The start of implementing the Dutch Spine Surgery Registry one year ago gives more insight in performed spinal surgery

and outcome in the Netherlands. Eventually, accreditation should be given to a spinal surgeon when performing an adequate number of surgeries a year. This could be of influence when care is concentrated to a few hospitals since expertise in spinal surgery is lost in this way.

Figure 3 shows notable diversity in timing with regards to surgical intervention of traumatic spinal injury with and without neurological deficit. To date, there is still no (inter)national consensus on when to operate traumatic spinal injury. Although various studies have been conducted on the topic of timing, a lack of sufficient evidence is reflected in the debate on timing in the recently updated AANS/CNS guidelines *(11)*. A recent review on the effects of timing in spinal surgery after traumatic SCI shows that "early" surgical intervention is associated with improved neurological and length of stay outcomes *(14)*. However, this study has a low level of evidence due to heterogeneity within and between studies. An observational multicenter cohort study compared "early" surgical intervention (< 24 hours) with "late" surgical intervention (> 24 hours) in acute spinal cord injury. This study found significant motor recovery improvement in incomplete acute spinal cord injury in the cervical, thoracic, or thoracolumbar spine, and shorter length of hospital stay *(5)*. In addition, another recent study suggested superior neurological recovery after traumatic cervical spinal cord injury if surgical intervention was performed within 8 hours after injury *(12)*. On the other hand, The STASCIS study revealed that patients with cervical SCI operated within 24h had a 2.83 times higher chance of improving 2 grades on the ASIA scale than patients operated later than 24h *(6)*. With these results no recommendations can be made with certainty in the case of timing of surgical intervention in traumatic spinal injury. This uncertainty is also reflected in our survey and suggests more clinical research on timing is necessary. An AO Spine sponsored study (SCI-POEM) is conducted on this issue at the moment, the final report to be delivered in 2017.

In the Netherlands, a majority of health care professionals (73%) involved in spinal trauma is in favor of more concentrated care for patients with spinal trauma (Table V). At the moment there are 11 national trauma centers where spinal trauma patients are eligible for treatment. As we have mentioned before, lack of agreement on when to operate imposes a prominent barrier for the implementation of a more concentrated level of spine care. Reimbursement is without doubt also a barrier on the path to implementing more concentrated care although this was not mentioned in this survey. However, more concentrated spinal care could lead to faster implementation of recent developments, guidelines and classifications, more possibilities for scientific research and higher quality of surgical experience. This may eventually result in better patient care and outcomes.

In conclusion, (inter)national collaboration in treating traumatic spinal injury is indispensable in order to achieve better communication, more spinal expertise, more research, and eventually good practical results. This survey has provided insight into the opinions of medical professionals involved in traumatic spinal injuries in the Netherlands. It is of interest that in this relatively small country opinions on the treatment of spinal injury differ substantially. However, being relatively small and with very good logistic possibilities small countries, such as the Netherlands could be one of the countries to lead the way on research in timing of surgery in SCI patients. This survey can be of use to show the discrepancies between trauma regions and further motivate conducting good clinical research in this important field.

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