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Traumatic Spinal Cord Injury (TSCI) in King Fahd Medical City, An Epidemiological Study

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Research Article

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Abstract

Introduction: Our study aims to estimate the characteristics & causes of TSCI at King Fahad Medical City (KFMC) in Riyadh city in order to hypothesize strategy for primary prevention of traumatic spinal cord injury.

Method: Cross-sectional, Retrospective study was conducted on all TSCI patients who aged 14 and above and who were admitted in rehabilitation center of King Fahad Medical City from January 2012 to December 2015. Furthermore, a descriptive analysis was conducted while considering factors including age, gender, marital status, educational level and causes of injury and characteristics of injury.

Results: Total of 216 patients were admitted during this period, mean age was 28.94, majority of patients were male (86.5%), 71.7% of total patients were high school level of education or less, 68% were single, RTA was the main cause with 90.7% and the main result of TSCI was complete paraplegia 37%. Furthermore, statistically we found that male are at a low risk of having incomplete paraplegia compared to female ($p = 0.035$, RRR=0.35).

Conclusion: The rate of TSCI related to RTA has increased in Saudi Arabia in previous years. Despite the government's efforts to decrease RTA. It's clear that we need TSCI registry data developed on the basis of international data standards to have a clear idea about the exact etiology of TSCI in Saudi Arabia. These will assist in planning for primary prevention.

Keywords: Tetraplegia; Traumatic spinal cord injury; Epidemiological Study

Abbreviations: TSCI: Traumatic Spinal Cord Injury; KFMC: King Fahad Medical City; RTA: Road Traffic Acciden; WHO: World Health Organization; IPSCI: International Perspectives on Spinal Cord Injury; PSMMC: Prince Sultan Military Medical City; ASIA: American Spinal Injury Association Impairment scale

Introduction

Traumatic spinal cord injury (TSCI) has been described by the World Health Organization (WHO) as any injury to the spinal cord that is caused by damage or trauma resulting from an external force such as, road accidents,

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falls or violence [1]. The characteristics of spinal cord damages are made in accordance with American Spinal Injury Association Impairment Scale (ASIA). These include paraplegia or tetraplegia and complete or incomplete according to location of injury and completeness of cord damage which is determined by the degree of motor and/or sensory loss (for more details appendix 1). SCI is a disastrous event & is a severe problem for society, individuals, family & community as it leads to high rate of mortality, disability [1] and secondary long term medical complication such as pressure ulcers, pneumonia, pulmonary embolism, deep venous thrombosis, recurrent urinary tract infection and others [2]. Around 250000 to 500000 patients annually suffering from TSCI around the world [1]. International Perspectives on Spinal Cord Injury (IPSCI) reports that the majority of patients with TSCI are young men between 20 to 30 years of age and road accidents are the leading cause of injury worldwide [1]. TSCI is very costly, in Canada it has been reported that the lifetime cost per person experiencing TSCI ranges from $1.5 million for incomplete paraplegia (IP) to $3 million for complete tetraplegia (CT) [3]. In Australia the lifetime cost for paraplegia is $5 million and $ 9.5 million for tetraplegia [4]. In United States the total annual cost of TSCI is about 7.736 $ billion [5].

Data of TSCI in Saudi Arabia is limited. A global map for incidence rate of traumatic spinal cord injury by Cripps et al., in 2011 reported 39 incidences per million in North America, 15 incidences per million in Europe, 16 incidences per million in Australia [6] and in turkey the incidence rate was12.5 per million. It has even been recorded that male: female ratio for these incidences was 2.5:1. RTA was the main cause (48.8%) followed by falls (36.5%) while 67.8% of TSCI were paraplegic and 32.2% were tetraplegia [7]. Another study conducted in Iran between 2011 and 2015, focusing on the characteristics of injury stated that 53.5% of patients were complete and 46.5% incomplete and RTA was the primary reason (61%) followed by falls (24.5%) and the incident male to female ratio was (3.8:1) [8].

Gender		
Characteristics of injury	**Female**	**Male**
Complete Paraplegia	8 (27.5%)	72 (38.5%)
Complete Tetraplegia	5 (17.2%)	31 (16.6%)
Incomplete Paraplegia	9 (31%)	44 (24.7%)
Incomplete Tetraplegia	7 (24.1%)	40 (21.4)
Total	29 (13.4%)	187 (86.6%)

Table 1: Characteristics of injury according to gender of the patients admitted to King Fahad Medical City, Riyadh, June 2012 to Dec 2015.

The incidence rate of TSCI in Jordan was reported at 18 incidences per million with male to female ratio of 5.8:1 with mean age recorded at 33 years old. The most common cause was RTA (44.4%) followed by bullet injuries (25.8%), complicated by paraplegic injury 68% and 32% tetraplegia [9]. The information estimates the incidence of TSCI in Saudi Arabia is still limited, therefore a gulf country such as Qatar which is culturally similar to Saudi is considered as a good example. The incidence rate of TSCI is around 12.5 incidences per million per year with main cause being RTAs (72%) of total incidences in Qatar [10]. In 2012, a study in Saudi Arabia was conducted by Alshahri et al. [11] on 307 patients. The study helped in identifying that TSCI patients were admitted in Prince Sultan Medical City during 2003 to 2008 and these patients included 88% male. Their mean age was 29.5 years and the main cause of TSCI was RTAs (85%). It has been reported that four-wheeled vehicles are the highest globally reported cause of RTAs [11].

Another recent study by Dr. Al-Jadid was performed on the patients of Prince Sultan Military Medical City. These patients were admitted for TSCI in the Rehabilitation Medicine Unit from August 1982 to November 2010 (n=466). The researcher reports that 80.1% of admitted patients experienced RTA [12]. Furthermore, researchers found that the Saudi Arabia has the highest Ratio in term of gender male to female ratio 9:1 while worldwide male to female ratio is near to 2:1 [1]. A study in Saudi Arabia examined the causes and effects of road traffic accidents in Saudi Arabia between 1971 and 1997. The study identified that 79.2% of TSCI were due to RTA and 5,64,762 people died or were injured due to road traffic accidents which is equivalent to 3.5% of the total population of Saudi Arabia at that time [13].

The highest incidence of TSCI in Saudi Arabia was reported due to RTA [11-13]. The high rate of RTA in Saudi Arabia is not quite surprising. According to General Directorate of Traffic of Saudi Arabia, during 2015 (1436 H) 5,18,795 incidences took place and alone in Riyadh city 1,47,568 these incidences were recorded [14]. Furthermore, car accidents accounted for 36,302 injury incidences out of which 2,803 injury incidences occurred in Riyadh city [14]. Furthermore 8,063 deaths were recorded in Saudi Arabia and out of this figure 858 deaths occurred in Riyadh city due to RTAs [14]. This figure is quite high as compared to the figures of 2009 which recorded 4,84,805 car accidents in Saudi Arabia while recording1,41,549 alone in Riyadh city [14]. Furthermore, a total of 34,605 injuries were recorded in Saudi Arabia and these included1, 604 injuries reported in Riyadh city alone [14]. Furthermore, 6142 deaths were recorded in Saudi Arabia and this included 364 deaths alone in Riyadh city [14].

Neurology & Neurotherapy Open Access Journal
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Limited studies in Saudi Arabia showed the accurate incidence of TSCI and examine the characteristics and causes of TSCI in PSMMC. Therefore, the aim of the study is to estimate the characteristics & causes of traumatic spinal cord injury (TSCI) in KFMC. KFMC is the only Ministry of Health (MOH) Hospital that provides acute holistic rehabilitation services to referred patients through an interdisciplinary rehabilitation program. It provides a major portion of the medical services offered in Riyadh city in order to help in the development of TSCI primary prevention strategies.

Materials and Methods

Setting

Rehabilitation center in King Fahad Medical City (KFMC), ministry of health (MOH)

Study Design

Cross sectional, Retrospective study of hospital records of TSCI patients admitted from January 2012 To December 2015 in rehabilitation center of King Fahad Medical City. KFMC is a tertiary hospital in Riyadh city and represents Ministry Of Health. The research was approved by research ethic committee in PSMMC and by Institutional Review Board (IRB) of KFMC.

Age at TSCI (years)	Gender		Marital status		Education level		
	Male	Female	Single	Married	Less than high school degree	High school degree	Higher educational Degree
14-25	107	11	10	5	10	74	34
26-35	46	7	7	24	13	24	16
36-45	11	5	8	12	8	3	5
46-55	4	4	8	15	1	5	11
56-65	2	0	6	8	0	1	7
65+	5	0	4	5	4	1	0
Total	187 (86.6%)	29 (13.4%)	29 (13.4%)	69 (32%)	49 (22.7%)	106 (49%)	61 (28.3%)

Table 2: Socio demographic characteristics traumatic spinal cord injury of patients admitted to King Fahad Medical City, Riyadh, June 2012 to Dec 2015.

Population

The patients who were included in the study were Saudi nationals except for two patients who were non-Saudis but were residents of Riyadh city. Patients aged 14 years or older at the time of injury and had experienced traumatic spinal cord injury in Saudi Arabia and were included in the study.

Exclusion Criteria

Any patients less than 14 years old, any other cause of spinal cord injury apart from trauma and any injured patients outside Saudi Arabia were excluded.

Sample Size Calculation

The data (all TSCI patients admitted from Jan 2012 To Dec 2015 in rehabilitation center of King Fahad Medical City) was collected from patient's files. A descriptive analysis was conducted on the basis of gender, age, marital status, and educational level, cause of SCI and characteristics of TSCI.

Data collection

The data was collected from patient's files and data included gender, age, marital status, educational level, cause of SCI and characteristics of TSCI.

The characteristics of TSCI were determined by ASIA (American Spinal Injury Association Impairment Scale) from International Standards for neurological and functional classification of SCI patients as follows:

Tetraplegia complete (TC), Tetraplegia incomplete (TI), Paraplegia complete (PC) and Paraplegia incomplete (PI).

Statistical Method

The study employed IBM SPSS statistic version 23 software to analyze data. The analysis consisted of

Neurology & Neurotherapy Open Access Journal
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descriptive statistics for continuous variables including age, represented by median and mean. Categorical causes of injury and characteristics of injury, represented by frequencies and percentages.

Simple descriptive analysis was used to describe association between variables; Multinomial Logistic Regression was employed to investigate the relationship and to find any association between the independent variables (age, gender, marital status, educational level and cause of injury) and the dependent variable (characteristics of injury).

Result

The total Number of TSCI patients involved in this study were two hundreds and sixteen.

Characteristics of injury				
Cause of TSCI	Complete Tetraplagia	Incomplete Paraplagia	Incomplete Tetraplagia	Total
RTA	32	46	42	196(90.8%)
Falls	1	3	2	7 (3.2%)
Penetrating Wound	3	4	3	13 (6%)
Total	36	53	47	216

Table 3: Cause of TSCI according to Characteristics of injury of patients admitted to King Fahad Medical City, Riyadh, June 2012 to Dec 2015.

The Demographic and Clinical Characteristics

86.5% of the patients were male (187/216) as compared to 13.4% patients who were female (29/216). 54.6% of the patients (118/216) were between 14 - 25 years old. The median age was 24 and the mean age was 28.94 (mean age of female patients was 33.31 & mean age of male patients was 28.26).

Education Level

We found that one hundred and fifty-five (71.7%) patients had completed high school level education or less. 68% of these patients or one hundred and forty-seven patients who experienced TSCI were single, and sixty-nine (31.9%) were married at the time of injury.

Causes Of TSCI And Level Of Injury

Road Traffic Accident (RTA) was the leading cause of TSCI (90.7 %), followed by penetrating wound (6.0%) and falls (3. 2%).

On other hand, 61.6 % of the patients experienced paraplegia (complete or incomplete), and 38.4% experienced tetraplegia. More than half of the patient (53.7%) had completed TSCI (37% paraplegia and 16.7% tetraplegia). We found that 24.5% experienced incomplete paraplegia and 21.7% experienced incomplete tetraplegia.

Road Traffic Accident was responsible for 93.1% of complete SCI and 88% of incomplete TSCI.

Age at the Time of Injury

(**Table 4**) shows that, 54.5% who were injured (118/216) belonged to the age group (14-25) and 60% of them were complete while 24.5% of TSCI were in the age group (26-35) and 58.4% of them were complete.

Number of TSCI in age groups (36-45) and (46-55) was equal, with those experiencing complete injury were 50% and 25% respectively. The lowest number of patients belonged to the age group of 56 and above and had experienced the lowest percentage of complete injury 15.3%.

Characteristics of injury				
Age At TSCI	Complete	Incomplete	Incomplete	Total

Neurology & Neurotherapy Open Access Journal
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(Years)	Tetraplagia	Paraplagia	Tetraplagia	
14-25	21	28	19	118(55%)
26-35	7	12	10	53(24.5%)
36-45	6	3	5	16(7.4%)
46-55	2	6	6	16(7.4%)
56-65	0	3	4	8(3.7%)
66+	0	1	3	5(2.3%)
Total	36	53	47	216

Table 4: Age at TSCI according to Characteristics of injury of patients admitted to King Fahad Medical City, Riyadh, June 2012 to Dec 2015.

Difference between male and female in characteristics of injury

Females (27.5%, 17.2% 31% and 24.1 %) experienced complete paraplegia, complete tetraplegia, incomplete paraplegia and incomplete tetraplegia respectively.

Males (38.5%, 16.5%, 23.5% and 21.5%) experienced complete paraplegia, complete tetraplegia, incomplete paraplegia and incomplete tetraplegia respectively.

Therefore, the higher percentage of females (55.1%) experienced incomplete injury as compared to 45% men who experienced incomplete injury.

(Table5) Depicts the findings of Multinomial Logistic Regression Analysis. This was done to find any association between the independent variables and the dependent variables (characteristics of injury).

The results indicated that the only statistically significant variable was male (compared to female) experiencing incomplete paraplegia ($p = 0.035$, <0.05). The results showed that males have relative risk ratios statistically significant and less than 1 (RRR=0.32). This means that males have less risk of experiencing incomplete paraplegia than females.

Dependent Category	Variables	RRR*	P-value**	95% confidence Interval of the Relative Risk	
				Lower Level	Upper Level
Complete paraplegia	Base Outcome				
Complete tetraplegia	Age	0.99	0.99	0.95	1.03
	Male†	0.48	0.48	0.14	1.59
	Married†	1.63	1.63	0.5	5.28
	Secondary	1.03	1.03	0.32	3.35
	Education†	0.78	0.78	0.22	2.74
	Higher Education†	2.39	2.39	0.14	41.25
	Fall†	2.33	2.33	0.49	12.34
	Penetrating Wound†				
Incomplete paraplegia	Age	1.03	0.075	0.99	1.06
	Male†	0.32	0.035	0.11	0.92
	Married†	0.59	0.359	0.2	1.81
	Secondary	0.56	0.936	0.36	2.59
	Education†	0.67	0.466	0.29	1.96
	Higher Education†	4.3	0.233	0.41	45.16

Neurology & Neurotherapy Open Access Journal
ISSN: 2639-2178

	Fall†	2.45	0.261	0.51	11.62
	Penetrating Wound†				
Incomplete tetraplegia	Age	1.02	0.093	0.99	1.06
	Male†	0.41	0.103	0.14	1.2
	Married†	1.15	0.795	0.39	3.41
	Secondary	0.56	0.239	0.21	1.47
	Education†	0.41	0.101	0.14	1.19
	Higher Education†	2.57	0.459	0.21	31.3
	Fall†	2.01	0.413	0.38	10.8
	Penetrating Wound†				

* RRR: Relative Risk Ratio* * The variable is considered significant if the p-value is less than 0.05 † The base comparison categories in these variables are female, single (not married), illiterates/primary education, and RTA respectively.

Table 5: Multinomial logistic regression (n=216).

(Is used to establish any association between the independent variables and the dependent variable (characteristics of injury). The method essentially based on using one category of the dependent variable as a bench mark to study the change in the other categories under the independent variables. In this study we used the characteristics of the injury (Complete paraplegia) as a bench mark for comparison. The variables coefficients are reported as relative risk ratios (RRR).

Figure 1& 2 depicts that total number of falls that caused TSCI was seven (100% were male), three of them (42.8%) were of the age group of 56 years old and above. This may have explained why we found 84.6% incomplete TSCI in this group (11/13) as was shown in table 4. Thirteen patients had penetrating wounds, while 61.5% of them were between 14-25 years old.

Road Traffic Accident was the main cause of TSCI (90.7%), and the majority of them by (50.4%) were from the age group (14-25), represented as 96.5 % and 89.8 % in women and men respectively.

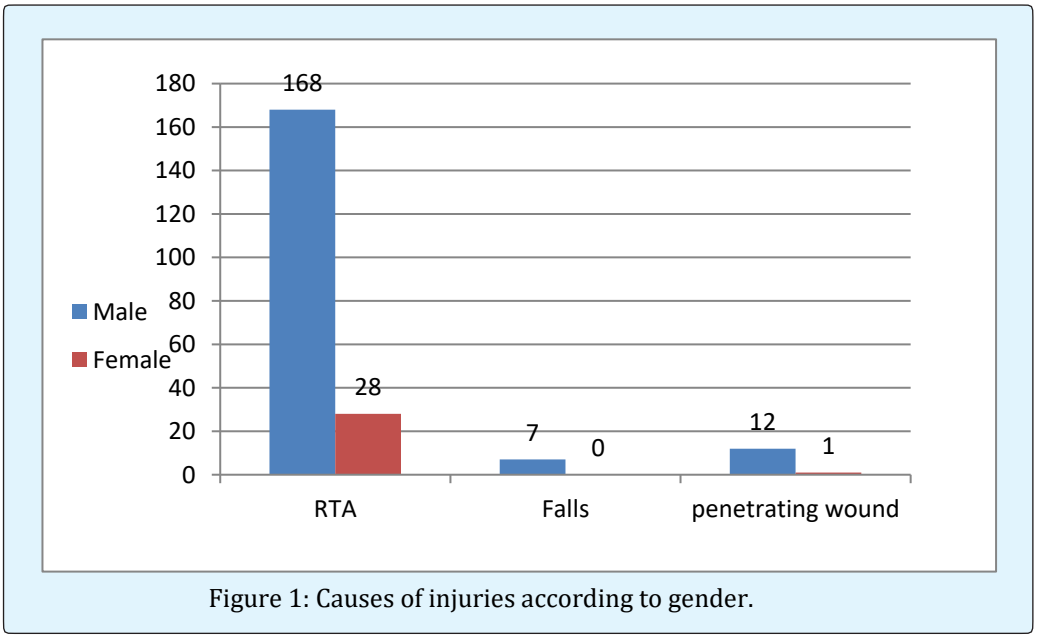

Figure 1: Causes of injuries according to gender.

Neurology & Neurotherapy Open Access Journal
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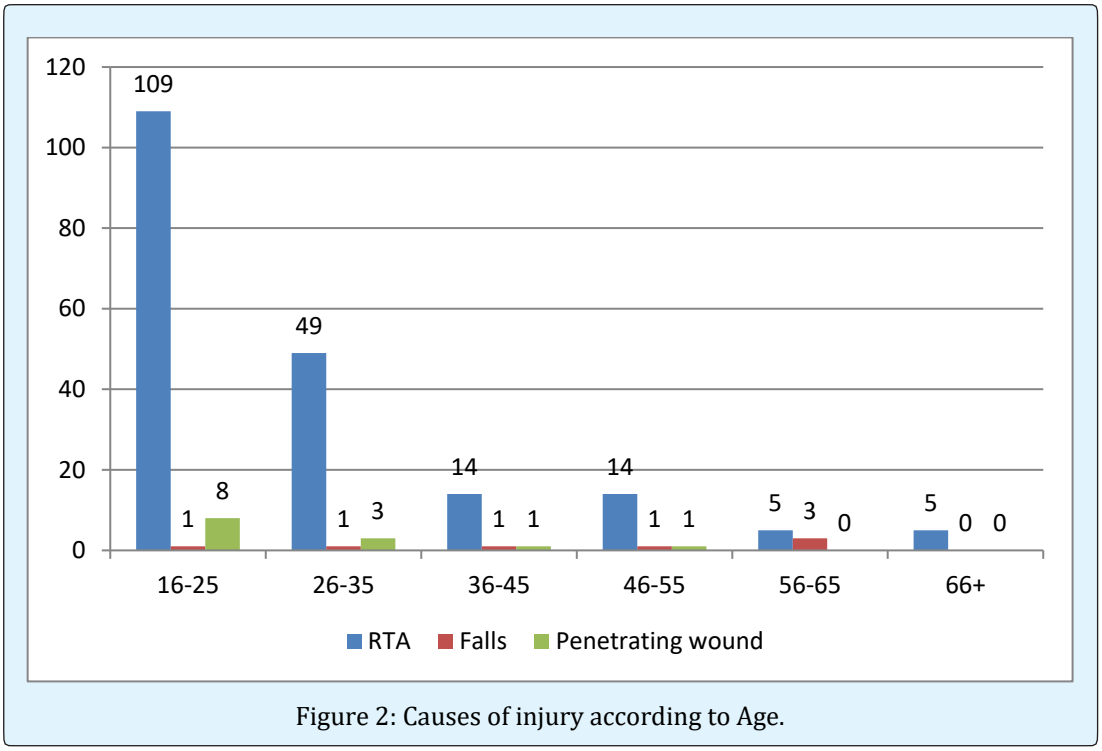

Figure 2: Causes of injury according to Age.

Discussion

This study depicted that there was an increase in the proportion of TSCI caused due to RTAs as compared to two previous studies, which had been done at the same city from PSMMC. The studies depicted that that TSCI related to RTA were 85% in 2012 [11] and 80.1% in 2013 [12]. This is of significant importance in the present study which has identified that there is no improvement despite the efforts, which have been done by the government to decrease RTAs. These efforts include safety cameras (SAHER) [14]. If we compare the proportion of TSCI related to RTA in Saudi Arabia from previous studies including this one and study conducted in Qatar (RTA 72%) [10], to north America, the prevalence of TSCI due to RTA 47% [6], it would not be wrong to suggest that this may be a part of wider regional problem. This could be related to many factors including cultural behaviors such as using phone during driving, not using the seat belt, speed, drifting, driving at very young age. Other factors may include the infrastructure like speed limit, lack of warning signs, community awareness and etc. We can't come to a clear conclusion unless the government comes with a national project to investigate in scientific and practical way to identify and evaluate risks. The government should then come with a plan targeting all factors. In this study we found that the male: female ratio is high (9:1) which was not surprising since similar findings have been obtained through studies conducted by Alshahri and Ansari [11,13]. This ratio is quite high as compared to the rations experienced in America (4:1 male: female ratio) [15]. This high ratio is likely because laws in Saudi Arabia does not allow females to drive and maybe because the driver is married and drives in a responsible manner in the presence of his family. The low level of education may have no significant value for my opinion. The majority of the sample in our study are less educated and this explains why most of the sample belonged to the age group of young adults. The high rate of complete paraplegia rings a bill about cultural education in helping and moving of injured patient by non-trained volunteered people instead of waiting for ambulance. Other causes for TSCI, penetrating wound and falls were very low as 6% and 3.2% respectively in Saudi Arabia compared to North America 16% and 20% respectively [6].

In an our study there is no TSCI cases reported due to sport injury comparing to only 1% in pervious study in Saudi Arabia [11] and 11% in north America. This could

Neurology & Neurotherapy Open Access Journal
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be related to lack of interest in playing sports, especially dangerous sports like mountain climbing and diving in Saudi Arabia.

Interestingly, we found that there is difference between male and female in characteristics of injury, as women experience more incomplete injury (55.1%) compared to men (45.0%) as showed in table 4. This could be explained by the fact that women who are involved in RTA are always a passenger which may change the mechanism of the trauma. Additionally, this maybe because the driver is usually more responsible in driving when a female or family is present and this leads to minor accidents as compared to accidents experienced by young and single individuals who drive in an un-responsible manner and are more prone to severe accidents due to speeding or drifting.

Nevertheless, we acknowledge some limitations such as the prevalence of TSCI in this study can't be reliably estimated because of the health system in Saudi Arabia is divided into military vs civilian. On other hand, KFMC has no clear geographic and population catchment. However, we don't have TSCI data registry system. Ideally, we should use data registry which is similar to International Classification of External injury (ICECI) [16]. While the rate of TSCI caused by RTA is the highest throughout the globe, this increases the need to do further investigations to analyze the causes of RTA. Unfortunately, we couldn't find in the records of the patients any descriptive information about the mechanism or the causes (internal/external) of the RTA.

In my opinion the strength of this research is that it is contributing to the existing data from previous researches regarding the high proportion of TSCI related to RTA. In this research we add more information about educational level as well as marital status. We also found statistically significant result of association between gender and characteristics of injury (males have less risk of having incomplete paraplegia than females).

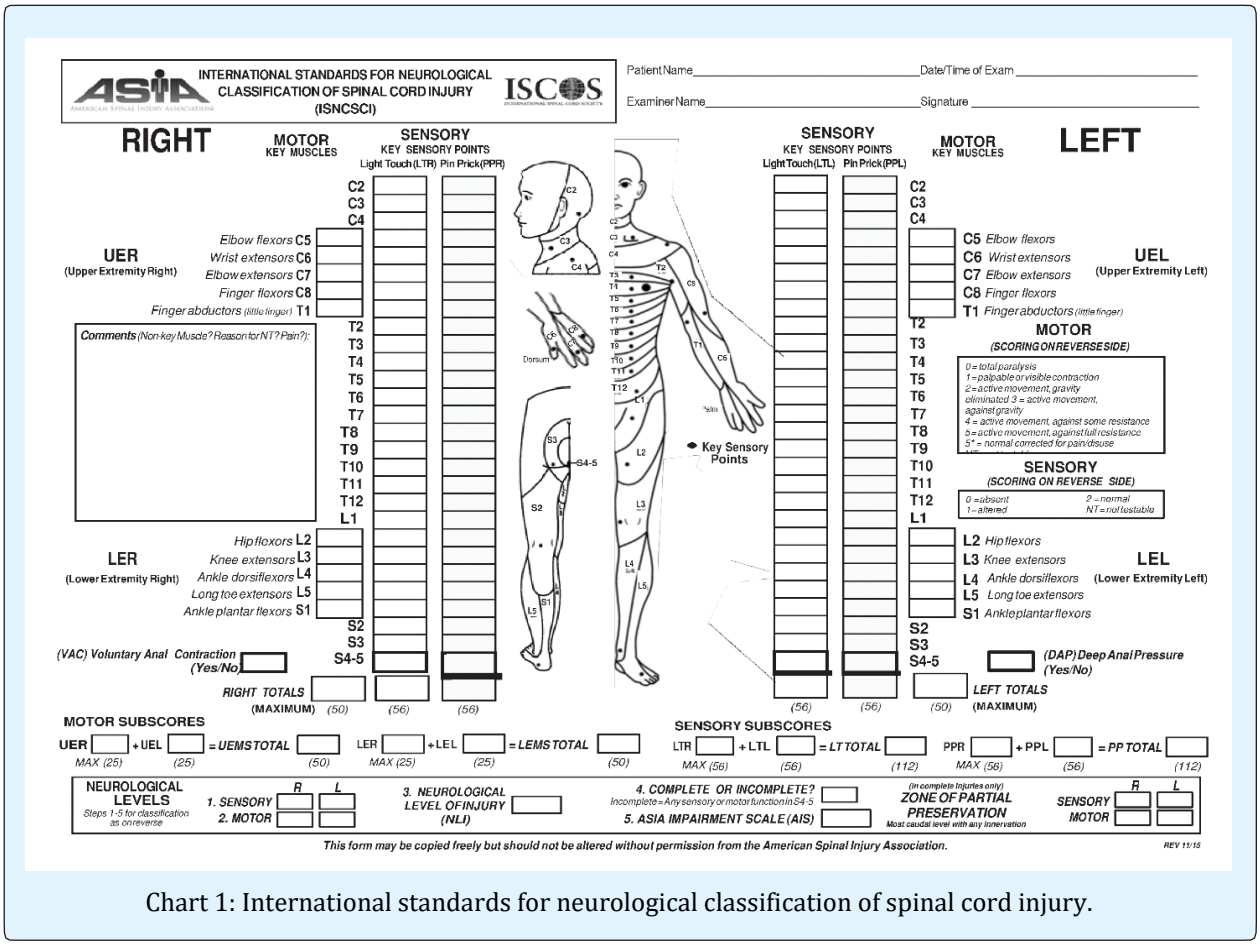

Chart 1: International standards for neurological classification of spinal cord injury.

Neurology & Neurotherapy Open Access Journal
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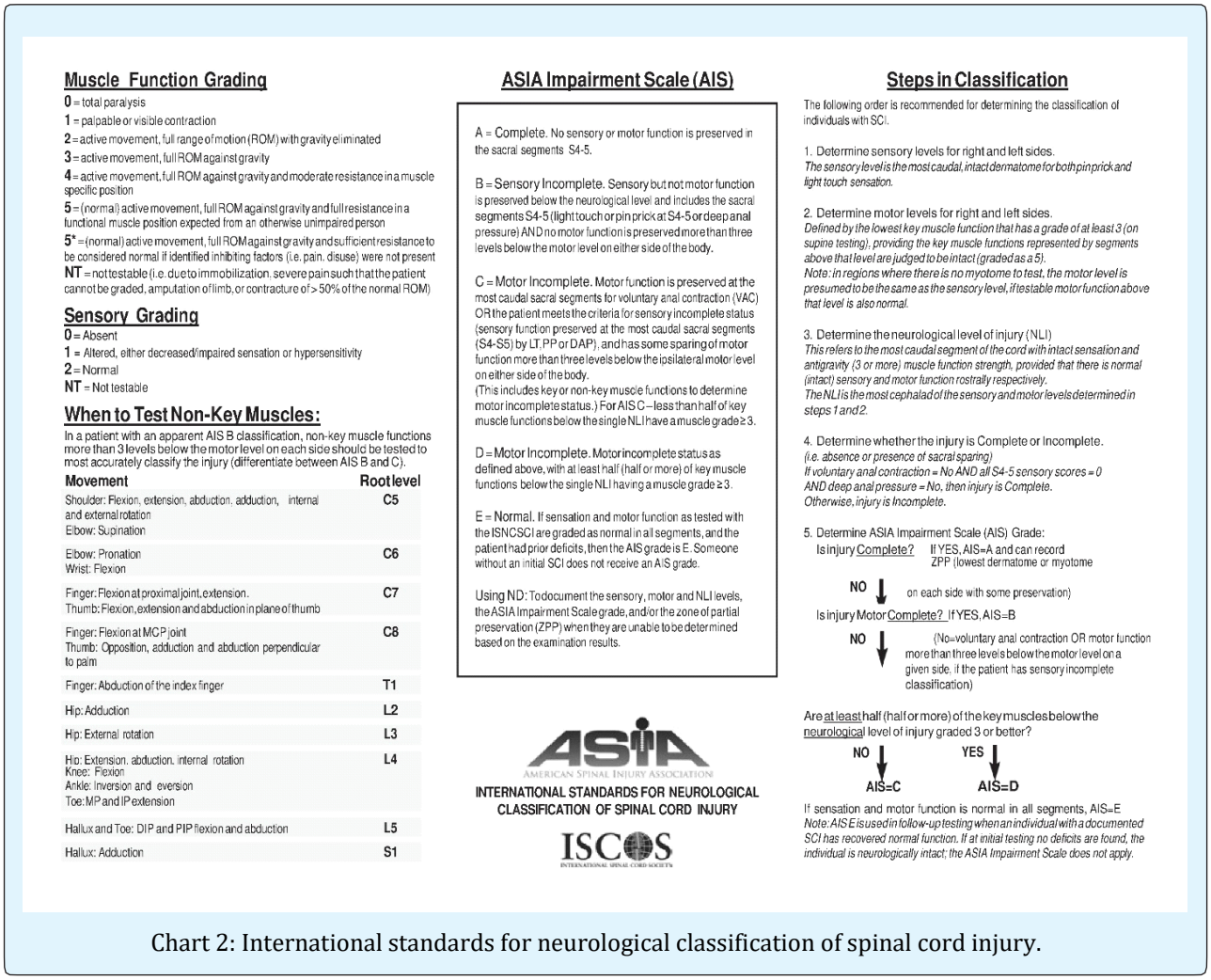

Muscle Function Grading

0 = total paralysis
1 = palpable or visible contraction
2 = active movement, full range of motion (ROM) with gravity eliminated
3 = active movement, full ROM against gravity
4 = active movement, full ROM against gravity and moderate resistance in a muscle specific position
5 = (normal) active movement, full ROM against gravity and full resistance in a functional muscle position expected from an otherwise unimpaired person
5* = (normal) active movement, full ROM against gravity and sufficient resistance to be considered normal if identified inhibiting factors (i.e. pain. disuse) were not present
NT = not testable (i.e. due to immobilization. severe pain such that the patient cannot be graded, amputation of limb, or contracture of > 50% of the normal ROM)

Sensory Grading

0 = Absent
1 = Altered, either decreased/impaired sensation or hypersensitivity
2 = Normal
NT = Not testable

When to Test Non-Key Muscles:

In a patient with an apparent AIS B classification, non-key muscle functions more than 3 levels below the motor level on each side should be tested to most accurately classify the injury (differentiate between AIS B and C).

Movement	Root level
Shoulder: Flexion, extension, abduction, adduction, internal and external rotation Elbow: Supination	C5
Elbow: Pronation Wrist: Flexion	C6
Finger: Flexion at proximal joint, extension. Thumb: Flexion, extension and abduction in plane of thumb	C7
Finger: Flexion at MCP joint Thumb: Opposition, adduction and abduction perpendicular to palm	C8
Finger: Abduction of the index finger	T1
Hip: Adduction	L2
Hip: External rotation	L3
Hip: Extension, abduction, internal rotation Knee: Flexion Ankle: Inversion and eversion Toe: MP and IP extension	L4
Hallux and Toe: DIP and PIP flexion and abduction	L5
Hallux: Adduction	S1

ASIA Impairment Scale (AIS)

A = Complete. No sensory or motor function is preserved in the sacral segments S4-5.

B = Sensory Incomplete. Sensory but not motor function is preserved below the neurological level and includes the sacral segments S4-5 (light touch or pin prick at S4-5 or deep anal pressure) AND no motor function is preserved more than three levels below the motor level on either side of the body.

C = Motor Incomplete. Motor function is preserved at the most caudal sacral segments for voluntary anal contraction (VAC) OR the patient meets the criteria for sensory incomplete status (sensory function preserved at the most caudal sacral segments (S4-S5) by LT, PP or DAP), and has some sparing of motor function more than three levels below the ipsilateral motor level on either side of the body.
(This includes key or non-key muscle functions to determine motor incomplete status.) For AIS C – less than half of key muscle functions below the single NLI have a muscle grade ≥ 3.

D = Motor Incomplete. Motor incomplete status as defined above, with at least half (half or more) of key muscle functions below the single NLI having a muscle grade ≥ 3.

E = Normal. If sensation and motor function as tested with the ISNCSCI are graded as normal in all segments, and the patient had prior deficits, then the AIS grade is E. Someone without an initial SCI does not receive an AIS grade.

Using ND: To document the sensory, motor and NLI levels, the ASIA Impairment Scale grade, and/or the zone of partial preservation (ZPP) when they are unable to be determined based on the examination results.

ASIA
AMERICAN SPINAL INJURY ASSOCIATION
INTERNATIONAL STANDARDS FOR NEUROLOGICAL CLASSIFICATION OF SPINAL CORD INJURY
ISCOS
INTERNATIONAL SPINAL CORD SOCIETY

Steps in Classification

The following order is recommended for determining the classification of individuals with SCI.

1. Determine sensory levels for right and left sides.
The sensory level is the most caudal, intact dermatome for both pin prick and light touch sensation.

2. Determine motor levels for right and left sides.
Defined by the lowest key muscle function that has a grade of at least 3 (on supine testing), providing the key muscle functions represented by segments above that level are judged to be intact (graded as a 5).
Note: in regions where there is no myotome to test, the motor level is presumed to be the same as the sensory level, if testable motor function above that level is also normal.

3. Determine the neurological level of injury (NLI)
This refers to the most caudal segment of the cord with intact sensation and antigravity (3 or more) muscle function strength, provided that there is normal (intact) sensory and motor function rostrally respectively.
The NLI is the most cephalad of the sensory and motor levels determined in steps 1 and 2.

4. Determine whether the injury is Complete or Incomplete.
(i.e. absence or presence of sacral sparing)
If voluntary anal contraction = No AND all S4-5 sensory scores = 0 AND deep anal pressure = No, then injury is Complete.
Otherwise, injury is Incomplete.

5. Determine ASIA Impairment Scale (AIS) Grade:
Is injury Complete? If YES, AIS=A and can record ZPP (lowest dermatome or myotome
NO ↓ on each side with some preservation)
Is injury Motor Complete? If YES, AIS=B
NO ↓ (No=voluntary anal contraction OR motor function more than three levels below the motor level on a given side, if the patient has sensory incomplete classification)
Are at least half (half or more) of the key muscles below the neurological level of injury graded 3 or better?
NO ↓ AIS=C
YES ↓ AIS=D
If sensation and motor function is normal in all segments, AIS=E
Note: AIS E is used in follow-up testing when an individual with a documented SCI has recovered normal function. If at initial testing no deficits are found, the individual is neurologically intact; the ASIA Impairment Scale does not apply.

Chart 2: International standards for neurological classification of spinal cord injury.

Conclusion and Recommendation

We found that there is an increase in TSCI related to RTA since 1997 [13]. Despite the government's efforts to decrease RTA. It's clearly that we need TSCI registry data developed as per international data standard to have a clear idea about the exact etiology of TSCI in Saudi Arabia in order to plan for primary prevention. On other hand we recommend further study to examine risk factors for TSCI which will help in primary prevention.

We need to involve more measures in order to decrease the rate of RTA, like cultural behavior changes through education and increase awareness of community while including informational sessions at school for young school goers. The media and primary care centers are part of health education especially for age group at risk.

Furthermore, we need stricter policies regarding responsible driving such as policies that promote using of seat belt. It is even necessary to review current infrastructural causes of TSCI such as speed limit, lack of road traffic signs etc.

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