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Dr. Ashish Naik
MS Orthopaedics, Department of
Orthopaedics, MGM Hospital
Kamothe, Navi Mumbai,
Maharashtra, India

Dr. Harsh Kotecha
Department of Orthopaedics,
MGM Hospital Kamothe, Navi
Mumbai, Maharashtra, India

Dr. Sanjeev K Singh
Second year Resident,
Orthopaedics, MGM Hospital,
Kamothe, Navi Mumbai,
Maharashtra, India

Dr. Mohit Issrani
Department of Orthopaedics,
MGM Hospital Kamothe, Navi
Mumbai, Maharashtra, India

Corresponding Author:
Dr. Sanjeev K Singh
Second year Resident,
Orthopaedics, MGM Hospital,
Kamothe, Navi Mumbai,
Maharashtra, India

Canadian C-spine rule (CCR) versus national emergency X- radiography utilization study (NEXUS) for screening cervical spine injury

Dr. Ashish Naik, Dr. Harsh Kotecha, Dr. Sanjeev K Singh and Dr. Mohit Issrani

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Abstract

Background: There is uncertainty about the optimal guidelines for screening clinically important cervical spine injuries following blunt trauma. The Canadian C Spine rule (CCR) and the National Emergency X Radiography Utilization system (NEXUS) are two widely accepted guidelines to help emergency physicians and trauma surgeons in case of cervical blunt trauma.

Methods: We conducted a prospective analytical study between June 2019 to July 2020 at Mahatma Gandhi Mission's Hospital (MGM), Navi Mumbai comparing the diagnostic accuracy of CCR and NEXUS as applied to alert patients with trauma who were in stable condition.

Result: Among the 400 trauma patients randomly selected for the study 280(70%) patients were male and 120(30%) were female. According to the NEXUS guidelines, 202(50.5%) patients and according to the CCR guidelines 210(52.5%) patients required radiography, however as per the results obtained from the cervical spine imaging only 20 (5%) patients had cervical spine injury. Both the NEXUS and CCR guidelines had similar true positive and false negative rates of 5% and 0.5% respectively. Both tests had sensitivity of about 91% and specificity 56.54% and 45.54% respectively.

Conclusion: Based on studies with modest methodologic quality and only one direct comparison indicated that both CCR and NEXUS carry the same sensitivity for evaluating which patients need to undergo cervical spine imaging. Further the NEXUS guidelines have the same effectiveness as CCR for determining which patients must be subjected to cervical spine imaging.

Keywords: NEXUS, CCR, cervical spine imaging, cervical spine injury

Introduction

Injuries to cervical spine frequently occur following trauma and are becoming increasingly more common. The ancient Egyptians appreciated such injuries and the Edwin Smith Papyrus stated that "If thou examines a man and find him unconscious of his two arms his two legs and urine drops without his knowing it is a dislocation of vertebra of his neck. Spinal trauma and the ensuing neurological problems transform a person's social life and result in significant economic and non-economic burden^[1]. Trauma cases are definitively the most common cause of hospital emergency department visits. Blunt trauma is among the most dangerous types of trauma due to the likelihood of damage in various organs, such as the neck and spinal cord^[2].

Cervical spine injuries occur frequently in cases of major trauma. In developed countries, the incidence of traumatic spinal injury is decreasing, but the same is not true for developing countries, in which the total numbers remain high and are largely caused by traffic accidents and falling from heights. Detecting cervical spine stability at the time of injury with the reduced consciousness that typically accompanies major trauma incidents is challenging.³ Injuries to cervical spine due to either road traffic accidents or fall from heights if unrecognized can have disastrous consequences in the form of paralysis or paraplegia increasing the burden on the health care system. To counter this trauma specialist started ordering X-rays of the cervical spine and immobilization of cervical spine which resulted in over diagnosis and thus increased financial costs. NEXUS and CCR guidelines have been devised for convenient and efficient clinical diagnosis of suspected cervical spine injuries.

The National Emergency X-Radiography Utilization Study (NEXUS) criteria were developed

to help clinicians determine whether cervical spine imaging can be safely avoided in appropriate patients. NEXUS guidelines were first introduced in 1992 and included the following five criteria: Absence of tenderness when touching the cervical spine, Absence of evidence of intoxication, Full consciousness, Absence of focal neurological lesions, Absence of damage causing distraction. If a patient is NEXUS criteria-negative, further imaging is likely unnecessary [1]. The Canadian Cervical-Spine Rule (CCR) developed in 2001 in ten Canadian emergency departments. This rule uses 3 high-risk criteria (age 65 year or older, dangerous mechanism, paresthesia in the extremities), 5 low criteria (simple rear-end motor vehicle crash, sitting position in emergency department, ambulatory at any time, delayed onset of neck pain, and absence of midline C-spine tenderness), and the ability of patients to actively rotate their necks, to determine the need for Cervical spine imaging [4].

The primary aim in the present study was to assess the relative sensitivity and specificity of CCR and NEXUS in patients with cervical spine injury.

Materials and Methods

Study design and setting

This prospective analytical study was conducted on patients presenting to the emergency department with history of road traffic accidents or fall from height or any trauma to the neck between June 2019 to July 2020 at Mahatma Gandhi Mission's Hospital (MGM), Navi Mumbai.

Study population

A total of 400 patients fulfilling the inclusion criteria were randomly selected and were included in the study. The study was commenced after approval from the institutional ethics committee board.

Inclusion and Exclusion criteria

Inclusion criteria were as follows: age >18, head and neck trauma, stable vital signs. Exclusion criteria included age <18, penetrating neck trauma, acute paralysis, known disease or abnormality of the spine, pregnancy.

Methodology

Prior to the commencement of the study, the medical staff were briefed on the study protocol. Considering that the guidelines consist of a checklist, clinicians were only expected to follow the checklist, resulting in no disagreements on account of limited options. In the emergency unit, initial evaluation was carried out by the emergency physicians and trauma surgeons, the clinical findings were recorded, and the need for cervical spine imaging was determined by both the guidelines. Two cervical view X-rays were obtained (AP, lateral) for all the patients, and if prescribed Computerized tomography was performed to assess the damage to the spine. Radiography images were interpreted by the radiologists who were aware of the clinical status of the patient but they were not aware of the study protocol. The emergency attending clinicians and the residents did not have any information about the imaging results until the initial survey were finished. Finally, the results obtained from both sets of guidelines were compared with each other.

Statistical analysis

The patients were evaluated using both CCR and NEXUS-guidelines and the results were documented. By using the indicators of sensitivity and specificity the accuracy of the

two guidelines was examined. All data were analyzed using SPSS version 15 using descriptive analysis. Guidelines were compared using Kendall's W test.

Results

In the present study 400 patients who presented to the emergency department of MGM, Kamothe were selected randomly. In the present study out of the 400 randomly selected patients 280 patients (70%) were male while 120 (30%) were female. Mean \pm SD of age of patients was 41.00 \pm 16.65 years. Mean \pm SD age of women and men were 41.46 \pm 19.8 years and 40.48 \pm 15.51 years respectively.

Table 1: Frequency of trauma mechanism.

Mechanism of Trauma	No. of patients	Percentage
Road Traffic Accident	240	60%
Fall from Height	120	30%
Direct Trauma to Neck	32	8%
Other	8	2%

In the present study Road traffic accident was the most common mechanism of trauma.

Table 2: Frequency of various parameters of NEXUS.

Parameters (NEXUS)	No of patients	Percentage
Cervical spine tenderness	80	20%
Evidence of intoxication	8	2%
Normal level of consciousness	320	80%
Focal Neurological Deficits	6	1.5%
Distracting painful injury	160	40%

In the present study by the NEXUS criteria 320 (80%) patients had a normal level of consciousness, 6 patients (1.5%) had a focal neurological deficit, 80 (20%) patients had cervical spine tenderness, 160(40%) of them had concurrent painful misleading injury and 8 (2%) patients had evidence of intoxication.

Table 3: Frequency of various parameters of CCR.

Parameters (CCR)	No of patients	Percentage
Age greater than or equal to 65 years	40	10%
Dangerous mechanism	260	65%
Paresthesias in extremities	8	2%
Simple rear vehicle collision	40	10%
Sitting position in emergency	120	30%
Outpatient status at any time after trauma	100	25%
Delayed onset of neck pain	8	2%
Cervical spine tenderness	80	20%
Ability to rotate neck 45 degrees to left and right	300	75%

In the present study 260 (65%) patients suffered from dangerous mechanism, 40 (10%) of them mentioned a rear vehicle collision, 80 patients (20%) had cervical spine tenderness, 300 patients (75%) had the ability to rotate their necks 45 degrees to the right and left.

According to the NEXUS and CCR guidelines, results of whether to do cervical spine imaging are as follows.

Table 4: Frequency of patients needed for cervical spine imaging.

	No of patients	Percentage	P value 0.003
NEXUS	202	50.5%	
CCR	210	52.5%	
Kendall's W test			

In the present study according to the NEXUS guidelines 202 (50.5%) patients needed radiography, and according to CCR guidelines, 210 (52.5%) of them required radiography. A significant correlation was found between the two guidelines. According to the results obtained from cervical spine imaging only 20 patients (5%) had cervical spine injury.

Table 5: True positive, true negative, false positive and false negative of CCR and Nexus.

Frequency (%)		
	NEXUS	CCR
True positive	20(5%)	20(5%)
True negative	216(54%)	184(46%)
False positive	166(41.5%)	220(55%)
False negative	2(0.5%)	2(0.5%)

Thus, in the present study both the NEXUS and CCR guidelines had similar true positive and false negative rates of 5% and 0.5% respectively. Both tests had sensitivity of about 91% and specificity 56.54% and 45.54% respectively.

Discussion

There is a considerable controversy among the emergency physicians, neurosurgeons and trauma surgeons regarding the need for cervical spine imaging in patients with suspected trauma to cervical spine. The NEXUS and CCR guidelines help in this regard.

In the present study, 400 trauma patients were examined in MGM Hospital, Kamotho by the Emergency physicians. All patients underwent cervical spine imaging. Stiell *et al.* (2003) in a study evaluated 8283 patients and reported the prevalence of cervical spine injury to be 2% [6].

In the present study, higher true negative rates were observed in the assessment method using NEXUS guidelines whereas the rates of false positive were observed to be lower than that with CCR guidelines. Therefore NEXUS guidelines were found to have perform better for evaluating patients.

In the present study the sensitivity for NEXUS and CCR guidelines are both 91%. In the study of Stiell (2003) [6], the sensitivity was observed to be 99.4% and 90.7% for CCR and NEXUS guidelines respectively and in the study carried out by Zoe *et al.* (2012) [5] the sensitivity of the Canadian C-spine rule ranged from 90% to 100% and sensitivity for NEXUS guidelines ranged from 83% to 100%. However in the present study the specificity for NEXUS and CCR guidelines are 56.54% and 45.54% respectively, in the study carried out by Stiell (2003) [6] *et al.*, the specificity for NEXUS and CCR guidelines was reported to be 36.8% and 45.1% respectively while in the study carried by Zoe *et al.* (2012) [5] the specificity for NEXUS guideline ranged from 83% to 100% and that of CCR guidelines was reported to be ranging from 1% to 77%, however the difference in the results between the two studies could be due to the difference in the sampling methods; Zoe's study followed a retrospective sampling method and 15 studies that examined these two guidelines were reviewed, while in the present study, 400 patients were evaluated prospectively by the guidelines.

The present study showed that these two guidelines have the same sensitivity in dealing with blunt trauma patients and evaluating their need for radiography. The NEXUS guidelines perform better than CCR guidelines in terms of eliminating cases that require no further radiologic interventions.

Finally other factors to be taken into account are the type of trauma, the time between the beginning of trauma and the

player's referral, the assessing person and the patient's assessment convenience when evaluating which guidelines to use. The limitations in the present study are a relatively small sample size and a short follow up period.

Conclusion

The present study indicated that both CCR and NEXUS carry the same sensitivity for evaluating which patients need to undergo cervical spine imaging. Further the NEXUS guidelines have the same effectiveness as CCR for determining which patients must be subjected to cervical spine imaging.

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