Abstract

Introduction: The most common cause of hospital emergency department visits are trauma cases that are caused by a variety of underlying causes. Unknown neck and spinal cord injuries and trauma and lack of early diagnosis can have catastrophic consequences such as paralysis of part or all of the organs.

Objective: To assess and compare the effectiveness and ease of doing two guidelines of National Emergency X-Radiography Utilization Study and (CCR) Rule (Cervical-Spine) Canadian C-Spine in trauma patients.

Methods: This study was begun after being approved by the Research Committee of the Faculty of Medical Sciences and receiving the approval of the ethics committee of the university. 200 trauma patients admitted to the emergency department of Imam Reza Hospital were randomly selected by Excel software and enrolled in the study.

Results: In this study, 200 trauma patients admitted to the emergency department of Imam Reza Hospital of Tabriz, who met the inclusion criteria and had none of the exclusion criteria, were studied. 69.5% of patients were male and 30.5% were women. According to NEXUS guideline, 47.5% of the patients were required to undergo neck radiography. According to CPR guideline, 57.5% of the patients were required to undergo neck radiography. The sensitivity was obtained 90% for neck radiography by NEXUS and CCR guidelines, while specificity was obtained 54.73% and 44.2% for NEXUS and CCR guidelines, respectively.

Conclusion: This study showed that the two guidelines have the same sensitivity in dealing with trauma patients to evaluate the need to undergo radiography. It seems that the NEXUS guideline has the same performance for handling trauma patients who need to undergo radiography. It has also better performance in the removal of cases that need no further radiologic investigations compared CCR guideline.

Keywords: (LLC) Low-Risk Criteria, (NEXUS) National Emergency-Radiography Utilization Study, (CCR) Canadian C-Spine Rule, cervical spine, traumatic patients

Introduction

It can be strongly said that in the present age, trauma cases are the most common cause of hospital emergency department visits. But the blunt trauma is one of the most dangerous types of trauma, because it can have serious complications due to the likelihood of conflict and injury in various organs such as the neck and spinal cord (1, 2). According to the statistics, annually, 13 million trauma patients with possibility of cervical spinal cord injury are treated in America and Canada (3, 4).

Cervical spine injuries are frequently occurred at the time of major trauma. Cervical spine stability detection at the time of injuries involving the consciousness of patients is difficult. Hence, determining the type of radiography and those who should undergo radiography is important.

Unknown neck and spinal cord injuries and trauma and lack of early diagnosis can have catastrophic consequences such as paralysis of part or all of the organs. (5) This makes emergency physicians, especially emergency specialists ask for neck radiology and imaging as the first step when they have patients with trauma. This exposes us to a huge flood of natural and without trouble radiography. Considering the above issues raises the question that perhaps this common approach has not been effective in detecting cervical injuries and leads to problems (6-10). Despite the fact that x-ray request is a very simple and inexpensive way to detect cervical injury, abundant use of it imposes an enormous cost to the health system (11, 12). In addition to the financial costs, immobility of patients when waiting for long hours for the x-ray, not only causes discomfort to patients and their companions, but also leads to an unnecessary accumulation and occupation of beds in the emergency room (13-15). All of these problems have caused numerous and significant conflicts and differences in opinion between doctors and also published guidelines on the use of x-rays. For convenient and efficient clinical decisions, especially in cases similar to this case, we can use a variety of related studies to design a chart based on the variables of the examination and simple tests to help physicians (16-20).

NEXUS guidelines were first introduced in 1992 and include five criteria as follows (21):

1. Absence of tenderness when touching cervical spine
2. Absence of intoxication evidences
3. Full consciousness
4. Absence of focal neurologic lesions
5. Absence of damage causing distraction

According to this guideline, in the case of the presence of all of the above, there is no need to take Lateral Neck radiographs in trauma patients (22). According to the study of Hoffman et al., 99.6% sensitivity and 12.9% specificity are expressed for NLC; this statistics has caused doctors recommend using this method (23). Recently, a group of emergency physicians in the state of Ottawa, Canada, introduced the CCR (Canadian C-spine Rule) evaluation method. CCR guideline has three criteria for the assessment of patients with neck trauma that specifies the patients with indication for neck radiography (24). As the previous method, this method evaluates the patient's condition and his need to imaging with 3 high-

risk criteria, 5 low-risk criteria and the patient's ability to rotate the head (25-27). Goddard reported in a study that CCR has a clear superiority in reducing unnecessary radiographic imaging in conscious adults with stable vital status and cervical spine injury compared to the doctor's unstructured judgment (28). Ian et al. showed that CCR has higher sensitivity and specificity and reduced the required cases for radiography (29). In a study conducted by Stiell et al. (2003), 2% of subjects had a neck injury. The study showed that in patients with complete consciousness, CCR has a better response (32). Zoe et al. (2012) demonstrated that CCR guideline has more accuracy than the Nexus guideline (33). Many studies have investigated the methods for evaluation of traumatic patients to facilitate making decisions about the way of performing X-rays and the people who must undergo X-rays. Therefore, guidelines that assist the assessment and can be used easily are always controversial (30, 31). Hence, we decided to design this study to assess its effectiveness and reliability.

Materials and Methods

This is a analytic descriptive double blind study about 3 major guide lines based on cervical trauma: NEXUS, CCR. This study was begun after being approved by the Research Committee of Tabriz Faculty of Medical Sciences and receiving the approval of the ethics committee of the university(ethics committee code: NO:5/4/7828 Date:2015/12/19). 200 traumatic patients admitted to the emergency room of Imam Reza Hospital were randomly selected by Excel software and enrolled in the study. Inclusion criteria was : age>18, Head and neck trauma, Stable vital signs, GSC=15 at las 48 hour, visible damage to the clavicular, dangerous mechanism of injury and exclusion criteria was age<18, penetrating neck trauma, acute paralysis, known disease of the spine, pregnancy. Before the study, during a one-hour session, medical staff got familiar with the study. Considering that the guidelines are fully as a check list, all residents and professors could perform in agreement and there is doubt or disagreement in examination. After entering the emergency, the initial evaluation was carried out by emergency attendants and emergency medicine residents. The clinical findings were in registered in patients' medical records and the presence or absence of obvious spinal injury was determined by both guidelines. Simple X-ray imaging was performed for all traumatic patients to reject the neck injury. If prescribed, computerized tomography was performed to assess the damage to the spine. Radiographic images were interpreted by radiologists. The radiologist knew about the clinical status of the patients, but he was not aware of the study and also the Emergency attending and residents did not have any information about the result of the imaging. The third person who has patients responsible had information about patients treatment survey. This third person had not any role in this study and only took follow patients treatment survey. Finally triple therapy was obtained for all patients and in case of high clinical differences with radiological findings, multiple trauma graph were done; and finally, the results were compared with the findings of both guidelines. The results of the patients' evaluation using both CCR and NEXUS-NLC guidelines are recorded in the check list. The accuracy of the two guidelines was examined using indicators of sensitivity and specificity. Gold Standard is to compare the results of the two guidelines referenced, simple graphs reports and the patients' CT scan. All data analyzed by SPSS version 15 using descriptive analysis, Mean±SD and frequency tables. For comparing to guide lines we use kendall's W test and correlation between guidelines.

Results

In this study, 200 traumatic patients admitted to the emergency department of Tabriz Imam Reza Hospital, who met the inclusion criteria and had no exclusion criteria, were evaluated. Of the total 200 patients studied, 139 (69.5%) patients were male and 61 (30.5%) of them were women. Mean ± SD age of the patients was 40 ± 17.75 years (CI:95% - 84,19). Mean ± SD age of women and men were 42.56 ± 20.8 years (CI:95% - 84,19) and 38.88 ± 16.51 years (CI:95% - 84,19), respectively.

The frequencies obtained in the results for the mechanism of trauma were as follows:

Table 4.1: Frequencies of the trauma mechanism in the patients studied

	Frequency	Percentage
Car accident	44	22
Pedestrian accident	34	17
Rollover	32	16
Fall from height	29	14.5
Motorcycle-car accident	24	12
Fall	21	10.5
Dispute	12	6
Staying under rubble	2	1

The most frequent reasons for referring are car accident, pedestrian accident, rollover; and fall from height and other causes are the next frequencies.

In the survey conducted for the patients according to NEXUS guideline, results for the frequency of different items discussed in this guideline are as follows:

Table 4.2: Frequency of different items discussed in NEXUS guideline

	Frequency	Percentage
Cervical spine tenderness	35	17.5
Evidence of intoxication	2	1
Normal level of consciousness	162	81
Focal neurologic deficits	5	2.5
Painful misleading injury	70	35

As shown in Table 4.2, 162 (81%) patients had a normal level of consciousness, while only 5 patients (2.5%) had a focal neurological deficit. In addition, 35 (17.5%) of patients had cervical vertebral tenderness, and 70 of them had painful misleading injury at the same time.

In another study conducted by the CCR guideline, the results of various items reviewed by this guideline in the studied patients were as follows:

Table 4.3: Frequency of different items discussed in CCR guideline

	Frequency	Percentage
Age greater than or equal to 65 years	26	13
Severe damage mechanism	127	63.5
Paresthesias in extremities	5	2.5
Simple rear vehicle collision	24	12
Sitting position in emergency	58	29
Outpatient status at any time after trauma	43	21.5
Delayed onset of neck pain	14	7
Cervical spine tenderness	34	17
The ability to rotate neck 45 degrees to left and right	144	72

As shown in Table 4.3, 127 (73.5%) patients suffered severe damage mechanism on the basis of CCR guidelines, but only 24 (12%) of them mentioned the rear vehicle collision. Moreover, 34 patients (17%) had cervical spine tenderness, but 144 patients (72%) had the ability to rotate their necks 45 degrees to the right and left.

In the results obtained to make decisions based on NEXUS guideline for radiography, the findings were as follows:

Table 4.4: Frequency of the results obtained for radiography based on NEXUS and CCR guidelines

	Frequency	Percentage	P-value
NEXUS	95	47.5	0.004*
CCR	115	57.5	

*Kendall's W test

As shown in Table 4.4, based on the NEXUS guideline, 95 (47.5%) patients needed radiography; and according to CCR guideline, 115 (57.5%) of them required to undergo radiography. Also we had significant correlation between two guidelines (P-value<0.001).

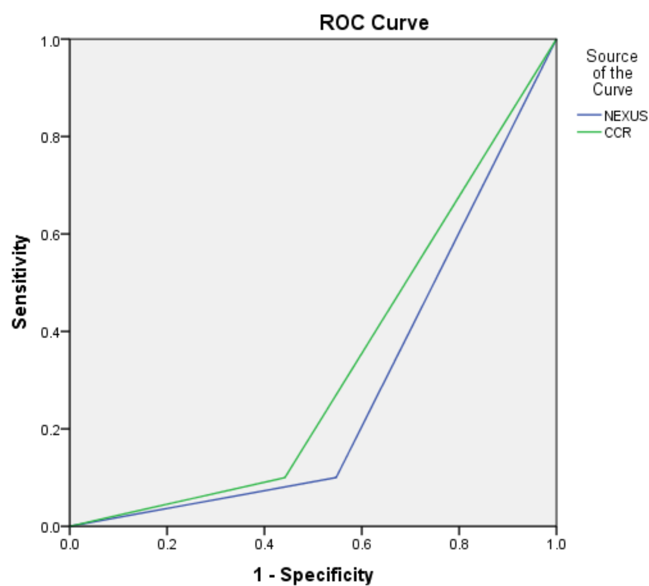
In the results obtained after neck radiography for patients, only 10 (5%) patients had neck injury in cervical spine and 190 (95%) patients had no cervical spine injuries.

In the analysis of data for the true and false positive and negative reviews using NEXUS and CCR guidelines, the results were as follows:

Table 4.5: True and false positive and negative reviews using NEXUS and CCR guidelines

	Frequency (%)	
	NEXUS	CCR
True positive	9 (4.5%)	9 (4.5%)
True negative	104 (52%)	84 (42%)
False positive	86 (43%)	106 (53%)
False negative	1 (0.5%)	1 (0.5%)

As shown in Table 4.5, true positive and false negative rates are similar in both guidelines and they are equal to 4.5% and 1%, respectively. In the survey conducted for sensitivity and specificity criteria for neck radiography by NEXUS and CCR guidelines, sensitivity of 90% is obtained for both guidelines, while the specificity was 54.73% and 44.2% for NEXUS and CCR guidelines, respectively.



Curve 4.1: ROC Cure for specificity and sensivity

Discussion

In the present study, we examined 200 traumatic patients who were referred to Imam Reza hospital emergency department. All the patients under investigation were undergone cervical spine radiography. 10 (0.5%) had findings in favor of cervical spine injury. In a study conducted by Stiell et al. (2003), the prevalence of cervical injury was reported 2%. The difference in the prevalence of cervical injury in these two studies can be affected by differences in sample size. In this study, 200 patients were examined, but 8283 patients were evaluated in the study carried out by Steill.

Both methods have the same value for true positive and false negative so that 90 out of 10 people suffered cervical spine injury were diagnosed by the evaluations, and only 1 patient had no need to radiography.

In this study, we observe higher true negative in the assessment method with NEXUS guideline. The rate of false positive obtained by NEXUS guideline is less than CCR guideline. Therefore, in the evaluation using the initial criteria, NEXUS guideline shows a better performance for the evaluation of patients.

In the analysis obtained, the sensitivity and specificity for NEXUS and CCR guidelines are the same and we see 90% sensitivity for both guidelines. But in the survey conducted for the specificity, NEXUS guideline had 54.73% specificity, while the specificity for CCR guideline is 44.2%. Given that in the study carried out by Zoe et al. (2012). It is shown that CCR guideline has more accuracy than NEXUS guideline for evaluation of patients. Therefore, the difference between the results of two studies can be due to differences in sampling methods in the two studies; the sampling method in Zoe’s study was retrospective, and 15 studies that examined these two guidelines had been reviewed, while in this study, 200 patients have been evaluated directly by the guidelines.

In the study of Stiell (2003), the sensitivity was 99.4% and 90.7%5 for CCR and NEXUS guidelines, respectively. They are similar to the values obtained in this study which is an approval for the sensitivity range in these guidelines. Also, in a study conducted by Hoffman et al., sensitivity of 99.6% has been suggested for NEXUS guideline that is consistent with the results of our study and confirms the present findings (2).

The specificity for CPR guideline in the study of Stiell (32) is reported 40.4% which is the same as the value obtained in our study, but the specificity of NEXUS guideline is 36.8%. The difference between the value obtained in this study and the value calculated in the present study can be influenced by the differences in the mechanism of damage in patients so that in the study conducted by Steill et al. (32), the most frequency was the motorcycle-car accident, and after that, the simple rear vehicle was the most frequent one. While in this study, the most frequent reason for referral are car accident, pedestrian accident, rollover and fall from height and other causes are the next frequencies.

Goddard was reported in a study that CCR has a clear superiority in reducing unnecessary radiographic imaging in conscious adults with stable status and cervical spine injury (28). Ian

et al. also demonstrated that in conscious patients who are stable, CCR criteria are preferred to NEXUS criteria (29). Steill et al. also noted that CCR guideline has better response to evaluate conscious patients.

The present study showed that the two guidelines have the same sensitivity in dealing with traumatic patients to evaluate the need to for radiography. It seems that the NEXUS guideline has the same performance for handling trauma patients who need to undergo radiography. It has also better performance in the removal of cases that need no further radiologic investigations compared CCR guideline.

But in any case, it must be in mind that written guidelines have never been non-negligible for the management of patients, and they can be changed according to the needs of the center and the study conditions; and guidelines' efficiency can be improved in some cases.

Finally, we recommend future studied to consider more effective factors such as the type of trauma, the time between the beginning of trauma and the patient's referral, the assessing person, the patients' assessment convenience for better transparency of the decision to use more effective and more precise guidelines. Region-based effective factors such as the number of cases referred and the work load and the number of participating medical staff and the individuals' familiarity with the management of guidelines and comfort level of the doctors must be evaluated.

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