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Rapid Assessment of Adults with Traumatic Brain Injuries

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Rapid Assessment of Adults with Traumatic Brain Injuries

Abstract

The aim of this evidence-based project was to improve the medical screening process, enhance medical decision-making, and standardized the utilization of an adult traumatic brain injury neuroimaging guideline among advanced practice providers in a rural emergency department. Neuroimaging, specifically computed tomography (CT) scans, help to identify life-threatening intracranial injuries when clinically appropriate. The literature supports the utilization of neuroimaging guidelines, clinical exam, and provider expertise when identifying the need for a head CT scan. Although head CT scans are clinically useful, they increase healthcare costs and pose potential cancer risks from radiation exposure. Eight advanced practice providers (i.e., nurse practitioners, physician assistants) were trained in the American College of Emergency Physicians' (ACEP) traumatic brain injury clinical guideline with one-on-one education. Pre-intervention, retrospective, baseline data were collected comprising a period of 4 months (n = 152). Three months of post-intervention data were collected to assess adherence to the guideline (n = 132), including physicians' charts that were reviewed as a comparison. The findings demonstrated a statistically significant reduction head CT scans that did not meet ACEP criteria (p = .010). The results of this project suggest improved medical-decision making among advanced practice providers, avoidance of unnecessary costs, and a reduction in radiation exposure for patients. This project could be easily replicated in other emergency department settings using the ACEP traumatic brain injury guideline as part of their standardized procedures, clinical policies, or protocols.

Key words: CT head guidelines, traumatic brain injury, Canadian CT head rule, NEXUS II, New Orleans rule, ACEP Traumatic Brain Injury.

Rapid Assessment of Traumatic Brain Injuries

Introduction

Traumatic Brain Injury (TBI) is a neurological disorder commonly seen in emergency departments (EDs) and is the result of direct head contact or the brain being struck against intracranial surfaces from acceleration/deceleration forces (Evan & Withlow, 2017). A mild TBI is often termed *concussion*. According to the American Academy of Neurology, concussion is a "trauma-induced alteration in mental status that may or may not involve loss of consciousness" (Evan & Withlow, 2017, p. 1). Nationwide, head trauma can be devastating, disabling, long lasting, and often life threatening; 30% of trauma-related deaths are attributed to head injuries (Taylor, Bell, Breiding, & Xu, 2017). In 2013, the Centers for Disease Control and Prevention estimated 2.8 million ED visits, hospitalizations, and deaths were due to TBIs (Taylor et al., 2017) The primary cause of TBI among all age groups was falls (47%); almost 80% of those patients were adults over 65 years old; the second most common cause was being struck by an object and accounted for 15% of all TBIs (Taylor et al., 2017). Just as prevalent, motor vehicle collisions also accounted for 15% of all TBI-related injuries (Taylor et al., 2017). The severity of a TBI can range from mild to severe depending on signs, symptoms, and mechanism of injury. Common TBI symptoms include headache, nausea, vomiting, retrograde amnesia, loss of consciousness, altered mental status, and confusion. Significant signs include skull deformities, hemotympanum, *battle signs* (i.e., bruising of mastoid process), *raccoon eyes* (i.e., bruising around the eyes), cerebral spinal fluid rhinorrhea, and profuse bleeding from the nose or ears. All patients with head trauma must be evaluated by a licensed health professional for suspected TBI. This evaluation includes a focused neurological assessment, Glasgow Coma Scale, and cognitive status. The use of neuroimaging, specifically head computed tomography

(CT) scans, is often recommended for TBIs in acute care settings. Research supports the utilization of clinical decision-making tools to guide the use of CT scans for head trauma (Evan & Withlow, 2017). The main purpose of this study was to evaluate advanced practice providers' (APPs; i.e., nurse practitioner, physician assistant) medical decision-making before and after the introduction of the neuroimaging guideline for adults (>16 years old) with minor head trauma. Secondary aims were to evaluate the number of non-criteria CT scans, elapsed wait times (e.g., medical screening examination [MSE]-to-CT scan order, patient arrival-to-disposition), and a comparison between APPs and physicians (i.e., MD, DO).

Clinical Guidelines

Three clinical-decision tools approved for head CT trauma were reviewed prior to the selection of the American College of Emergency Physicians (ACEP) Mild TBI Clinical Policy: The Canadian CT Head Rule (CCHR), New Orleans Criteria (NOC), and the National Emergency X-Radiography Utilization Study II (NEXUS II). In one large study that revised the CCHR, Steill et al. (2001) reported a 98.4% sensitive and 49.6% specificity at identifying intracranial lesions. A study by Alonso et al. (2016) compared the CCHR to the NOC and reported both clinical guides at 100% sensitivity; however, the NOC had a mere 7.6% specificity. A large study by Ro et al. (2011) compared all three clinical guides with similar results for the CCHR, and NOC. However, the NEXUS II criteria had a 95.1% sensitivity and 41.4% specificity.

The ACEP TBI clinical policy was developed after a critical analysis of the literature for both CCHR and NOC. The study identified the strengths and limitations of both guidelines. The results gave creation to one policy with multiple levels of recommendation for patients

presenting with a mild TBI with or without loss of consciousness or posttraumatic amnesia (Jagoda et al., 2009).

After careful examination of these three guidelines, the ACEP Mild TBI clinical policy was found to be superior (Table 1). This clinical policy is supported and approved by the ACEP Board of Directors, Emergency Nurses Association, and the Centers for Disease Control and Prevention.

Methods

Study design. This study was a nurse-practitioner led, retrospective medical-record review of APPs managing patients presenting with the chief complaint of head injury in a rural ED. Pre-intervention data were collected for a period of 4 months. Subjects in the intervention group included both nurse practitioners (NP) and physician assistants (PA). The physician records were also monitored for comparison. The emergency NPs and PAs were educated on the ACEP Mild TBI clinical policy. The guideline was introduced as a standardized procedure for adults with head trauma. Post-intervention data were collected for a period of 3 months for both the intervention group (APPs) and comparison group (physicians).

Study setting. The hospital was located in a rural area in Southern California; one of the most underserved population areas in California. The ED of this hospital treats an average of 50,000 patients annually and is classified as level IV basic emergency medical service hospital. The APP liaison and director approved this study with a waiver of informed consent. Institutional Review Board approval was also given by the University of San Diego.

Study protocol. A query of the ED electronic medical record system was performed for patients with the chief complaint of *head injury*. Participant selection was limited to patients age

16 years and older. Charts excluded from the study included those patients who did not specify a head injury in the chief complaint at the time of registration.

A standardized medical record review was conducted for a total of 7 months utilizing a data collection form that served as a guide. It defined all the variables needed with details of each variable to be abstracted from the electronic medical record. The University of San Diego's Doctor of Nursing Practice faculty adviser and statistical analysis adviser assisted with the developed the data collection form. Any data discrepancies were resolved via consensus review with the faculty advisers.

Measurements. Data collected included chief complaint, demographics, CT scan results, background of medical provider (i.e., APP, physician) and disposition (i.e., discharge, admission, elopement). The elapsed time (i.e., number of minutes) was calculated from the documented times of (a) patient arrival, (b) head CT scan order, (c) MSE, and (d) disposition, including patients who did not receive a head CT scan. More importantly, all charts were reviewed to determine if patients met criteria for a head CT scan using the ACEP TBI clinical policy. Validation was made by reviewing the providers and nurses' notes. Patients not receiving a head CT scan were also evaluated to determine whether they met criteria for a head CT scan.

Reviewed documentation included history of present illness, review of systems, physical exam, medical-decision-making notes, chart addendums, nurses triage note, and nurses' exams. The nurses' notes were reviewed for comparison and to identify any information missing from the provider's charting. The nurses' notes were also reviewed in the effort to support the providers' clinical decision-making. This proved particularly helpful when the providers' documentation was poor or missing valuable information. The ACEP TBI clinical policy recommendations A and B were applied to all the charts reviewed. Pre-intervention data included

152 reviewed charts and post-intervention data comprised 122 charts. Therefore, a total of 274 charts were reviewed over a period of 7 months.

Data analysis. The data analysis for this project was done with SPSS (Version 24). An independent chi-squared test analyzed nominal data frequencies, including non ACEP criteria head CT scans for APPs and for physicians. Independent sample *t*-tests were used to analyze pre- and post-intervention continuous data, including the time intervals from patient arrival to MSE; arrival to disposition, MSE to CT scan order, and MSE to disposition. The results were evaluated for any statistical significant differences (Table 2).

Findings

The primary objectives were to determine if the order of a head CT scan met the ACEP criteria, APP adherence to guideline, and provider deviation from the recommendation. The difference in frequency of APPs' appropriate ordering of head CTs pre- and post-intervention was statistically significant ($\chi^2 = 6.658$, $p = .010$) with APPs improving in meeting ACEP guidelines post-intervention. The percent of CT scans against ACEP guideline went from 26.2% of the time in the pre-intervention group to 5.1% of the time post-intervention. The difference in physicians pre- and post-intervention was not statistically significant ($\chi^2 = 1.176$, $p = .278$); they continued to deviate from the ACEP guideline at a similar rate (Table 3). Additional findings identified that six of the eight APPs were unaware of any TBI CT scan clinical rules prior to the intervention, one APP knew the ACEP TBI clinical policy, and the other APP was familiar with the NOC. Both guidelines were included in the APP acute standardized procedures.

The second objective was to measure the average elapsed times from patient arrival to disposition, patient arrival to MSE, patient arrival to CT order, and MSE to CT order. Pre- and post-intervention group APP results were compared to physician results. There was no difference

in the elapsed time/throughput of patients between APPs and physicians at each measure except that the total time in the ED was significantly longer when physician performed MSE (M_{APPs} = 222.9 min, $M_{physician}$ = 303.48 min, p = < .001). The time from MSE to disposition was also significantly longer when physicians performed MSE (M_{APPs} = 187 min, $M_{physician}$ = 266 min, p = < .001; Table 2).

The third objective was to measure the average length of stay for patients not receiving a CT scan pre- and post-intervention among APPs. Wait times were longer for the MSE (M_{pre} = 31.8 min, M_{post} = 44.91 min, p = .155), shorter for arrival-to-disposition (M_{pre} = 172.6 min, M_{post} = 158.5 min, p = .512), and shorter for MSE-to-disposition (M_{pre} = 142.5 min, M_{post} = 114.8 min, p = .168). However, these differences were not statistically significant.

Additional results. Out of 284 charts reviewed, there were 212 head CT scans ordered in this project; 15 reported positive CT scans (e.g. subdural hematoma, intracranial bleed, subarachnoid hemorrhage). In total, the pre-intervention data had 19 non-criteria CT scans compared to 7 non-criteria CT scans in the post intervention data among all providers. Out the seven non-criteria CT scans in the post-intervention group, five of them belong to physicians and two to the APP group. All 26 non-criteria head CT scans had negative results. Furthermore, the elopement rate did not change in the post-intervention group.

Limitations

The first limitation of this project was lack of physicians' documentation. All of the physicians used scribes; some charts contained poor documentation, even devoid of explanation or interpretation of the head injury. Some of the data were obtained from the nurses' triage notes. Secondly, data were limited to patients with the chief complaint of head injury at the time of registration. Patients with other chief complaints (e.g., falls, motor vehicle collisions) who did

not specify head injury were not included in the study. Lastly, post-intervention data were not collected during the same time of year as the pre-intervention data. Higher patient volumes presented to the ED during the post-intervention period, likely due to the flu season.

Potential Cost Benefit Analysis

The billing department was contacted to identify the Current Procedural Terminology (CPT) code for STAT (immediate) non-contrast head CT scans. The billing cost is $3,116.00 The reimbursement practices by each type of insurance was also identified. MediCal reimbursements were $131.03, Medicare was $320.65, and Blue Shield/Blue Cross had a flat rate negotiated for each visit. Adhering to the ACEP TBI clinical policy offers a potentially large cost avoidance to the hospital.

Implications for Nursing Practice

Implementation of the ACEP TBI clinical policy demonstrated improved triage, medical screening, and medical-decision-making among APPs. Introduction of this clinical guideline created a new strategy for APPs in documenting the decision to order a head CT scan for patients with head trauma. This guideline assisted APPs in resolving a clinical issue with potential safety concerns from radiation exposure and a cost-effective consequence from reduction in unnecessary, non-criteria head CT scans.

In terms of advanced practice nursing and education, more research will be needed. The ACEP TBI clinical policy is the most current and best guideline supported by research, but it can be improved. Patients undergo considerable radiation exposure with the use of head CTs in order to rule out intracranial hemorrhages. While one of the biggest concerns in emergency medicine is the fear of litigation by missing an acute brain injury, more research needs to be done using "patient and provider shared-decision-making" with stricter ER return precautions and close

outpatient follow-up. This would help reduce unnecessary radiation exposure when the sequela of radiation outweighs the benefits of the test. Furthermore, this could also help reduce healthcare costs and reduce the rist of litigation.

Conclusion

Review of the literature revealed strong support for the use of the ACEP TBI clinical policy when compared to the CCHR, NOC, or NEXUS II rules. The use of the ACEP TBI clinical policy by APPs demonstrated a significant reduction of non-criteria CT scans, improved medical-decision-making, a small decrease in the ED length of stay, and a potential cost savings. There was no significant change in length of stay, MSE-to-CT scan order time, or elopement rate. Although this study was small, it provided evidence that APP use of the ACEP TBI clinical policy created a significant, positive difference with a significant drop of non-criteria head CT scans among APPs. The results for the physician-comparison group remained the same. In terms of clinical policy, these results cannot be generalized to other EDs; however, it may prove useful to other providers wanting to use the ACEP TBI clinical policy or as an APP standardized procedures. Additionally, physicians may benefit from this intervention and adherence to the ACEP TBI clinical policy as is planned for this study hospital.

References

Alonso, J. V., del Pozo, F. J. F., Álvarez, M. V., Lopera, E. L., Segura, M. G., & Arévalo, R. G. (2016). Comparison of the Canadian CT head rue and the New Orleans criteria in patients with minor head injury in a Spanish hospital. *Medicina Clinica, 147,* 523-530. http://dx.doi.org/10.1016/j.medcle.2016.12.040

Evan, R. W., & Withlow, C. T. (2017). Acute mild traumatic brain injury (concussion) in adults. *UpToDate.* Retrieved from https://www.uptodate.com/contents/acute-mild-traumatic-brain-injury-concussion-in-adults

Jagoda, A. S., Bazarian, J. J., Bruns, J. J., Cantrill, S. V., Gean, A. D., Howard, P. K., . . . Whitson, R. R. (2009). Clinical policy: Neuroimaging and decisionmaking in adult mild traumatic brain injury in the acute setting. *Annals of Emergency Nursing, 35,* e5-e40. http://dx.doi.org/10.1016/j.jen.2008.12.010

Ro, Y. S., Shin, S. D., Holmes, J. F., Song, K. J., Park, J. O., Cho, J. S., . . . Traumatic Brain Injury Research Network of Korea. (2011). Comparison of clinical performance of cranial computed tomography rules in patients with minor head injury: A multicenter prospective study. *Academic Emergency Medicine, 18,* 597-604. http://dx.doi.org/10.1111/j.1553-2712.2011.01094.x.

Stiell, I. G., Wells, G. A., Vandemheen, K., Clement, C., Lesiuk, H., Laupacias, A., . . . Worthington, J. (2001). The Canadian CT head rule for patients with minor head injury. *The Lancet, 357,* 1391-1396. http://dx.doi.org/10.1016/S0140-6736(00)04561-X

Taylor, C. A., Bell, J. M., Breiding, M. J., & Xu, L. (2017). Traumatic brain injury–related emergency department visits, hospitalizations, and deaths – United States, 2007 and

2013. *Morbidity and Mortality Weekly Report*, *66*(9), 1–16. Retrieved from https://www.cdc.gov/mmwr/volumes/66/ss/ss6609a1.htm

Table 1

American College of Emergency Physicians Mild Traumatic Brain Injury Clinical Policy: Decision-making in Adult Mild Traumatic Brain Injury in the Acute Setting

Level A Recommendation for Non-Contrast Head CT	
Head trauma patients *with* posttraumatic amnesia or loss of consciousness *and* one or more:	
Headache	Evidence of trauma above the clavicle
Vomiting	Posttraumatic seizure
Age >60 years old	GCS score <15
Drug or alcohol intoxication	Focal Neuro deficits
Deficits in short-term memory	Coagulopathy
Level B Recommendation for Non-Contrast Head CT	
Head trauma patients *with no* posttraumatic amnesia or loss of consciousness *and* one or more	
Focal neuro deficits	Signs of basilar skull fracture
Vomiting	GCS <15
Severe headache	Coagulopathy
Age > 65 years old	Dangerous mechanism of injury[a]

Note: Adapted from "Updated mild traumatic brain injury guideline for adults," by the Centers for Disease Control and Prevention, 2008, *Heads up to clinicians* [series]. Retrieved from https://www.cdc.gov/traumaticbraininjury/pdf/tbi_clinicians_factsheet-a.pdf

[a]Dangerous mechanism of injury includes ejection from a motor vehicle, a pedestrian struck, and a fall from a height of >3 feet or 5 steps.

Table 2

Disposition Time by Provider at Medical Screening Exam (MSE)

Time Interval	Provider	*N*	*M*	*SD*	*t*	*p*
Arrival to Medical Screening Examination (MSE)	APP	120	36.40	32.23	0.049	.961
	MD	161	36.63	43.08		
MSE to CT Order	APP	81	9.79	17.75	1.344	.180
	MD	130	14.51	28.30		
Arrival to CT Order	APP	81	50.19	40.00	0.411	.681
	MD	130	47.64	45.93		
Arrival to Disposition	APP	120	222.90	101.54	3.689	<.001
	MD	161	303.48	222.60		***
MSE to Disposition	APP	120	186.50	97.63	4.003	<.001
	MD	161	266.86	228.22		***

*$p \leq .05$, **$p \leq .01$, ***$p \leq .001$

Table 3

Advanced Practice Providers'(APP's) and Physicians' CT Orders Meet ACEP Guideline

		Meets ACEP Guideline				
Practitioner	Pre/Post	Yes	No	Total	χ^2	*p*
APP	Pre	31 (73.8%)	11 (26.2%)	42		
	Post	37** (94.9%)	2 (5.1%)	39	6.658	.010
Physician	Pre	62 (84.9%)	11 (15.1%)	73		
	Post	52 (91.2%)	5 (8.8%)	57	1.176	.278
Total	Pre	93 (80.9%)	22 (19.1%)	115		
	Post	89* (92.7%)	7 $7.3%)	96	6.186	.013
	Total	182 (86.3%)	29 (13.7%)	211		

*$p \leq .05$, **$p \leq .01$, ***$p \leq .001$