ความแม่นยำของการแปลผลเอกซเรย์คอมพิวเตอร์สมองของแพทย์เพิ่มพูนทักษะ ณ ห้องฉุกเฉินช่วงนอกเวลาราชการ โรงพยาบาลศูนย์การแพทย์สมเด็จพระเทพฯ

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บทคัดย่อ

ความแม่นยำของการแปลผลเอกซเรย์คอมพิวเตอร์สมองของผู้ป่วยเบื้องต้นมีความสำคัญมากและส่งผลต่อคุณภาพการดูแลรักษาผู้ป่วยเบื้องต้นโดยเฉพาะช่วงนอกเวลาราชการซึ่งแพทย์ส่วนใหญ่ที่ดูแลคือ แพทย์เพิ่มพูนทักษะ การศึกษานี้มีวัตถุประสงค์เพื่อทำการประเมินความแม่นยำของการแปลผลเอกซเรย์คอมพิวเตอร์สมองโดยแพทย์เพิ่มพูนทักษะในช่วงนอกเวลาราชการ โรงพยาบาลศูนย์การแพทย์สมเด็จพระเทพฯ ในช่วงมกราคม 2553 ถึงธันวาคม 2555 พบว่ามีการตรวจเอกซเรย์คอมพิวเตอร์สมอง 125 ครั้ง ซึ่งถูกแปลผลโดยแพทย์เพิ่มพูนทักษะ หลังจากนั้นภาพดังกล่าวจะถูกอ่านทบทวนโดยรังสีแพทย์ที่มีประสบการณ์ 2 ท่าน เมื่อเปรียบเทียบผล พบว่าความแม่นยำของการแปลผลเอกซเรย์คอมพิวเตอร์สมองในหมวดหมู่ภาวะเส้นเลือดสมองตีบ เลือดออกในสมอง กระดูกกะโหลก และกระดูกใบหน้าแตกร้าว ก้อนเนื้องอกในสมอง น้ำคั่งในโพรงสมองและสมองเลื่อน เป็นร้อยละ 80.8, 91.2, 96.8, 99.2, 92 และ 92.8 ตามลำดับ และความเห็นในการแปลผลเอกซเรย์คอมพิวเตอร์สมองโดยแพทย์เพิ่มพูนทักษะซึ่งถูกอ่านทบทวนโดยรังสีแพทย์ พบว่ามีความเห็นตรงกัน ความเห็นไม่ตรงกันอย่างมีนัยสำคัญ และความเห็นไม่ตรงกันอย่างไม่มีนัยสำคัญ เป็นร้อยละ 66.4, 21.6 และ 12 ตามลำดับ และพบว่าในภาพรวมการแปลผลเอกซเรย์คอมพิวเตอร์สมองมีความไวค่อนข้างต่ำแต่มีความจำเพาะค่อนข้างสูง สรุปว่าความแม่นยำของการแปลผลเอกซเรย์คอมพิวเตอร์สมองโดยแพทย์เพิ่มพูนทักษะช่วงนอกเวลาราชการมีค่าต่ำที่สุดคือ ภาวะเส้นเลือดสมองตีบ และมีค่าสูงที่สุดคือ ก้อนเนื้องอกในสมอง การให้ความรู้ในการอ่านแปลผลภาพเอกซเรย์คอมพิวเตอร์สมองจึงมีความสำคัญเพื่อปรับปรุงคุณภาพการรักษา

คำสำคัญ: ความแม่นยำของการแปลผล เอกซเรย์คอมพิวเตอร์ แพทย์เพิ่มพูนทักษะ

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Accuracy of brain computed tomography interpretation by internists at emergency room after official hour periods in HRH Princess Maha Chakri Sirindhorn Medical Center

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Abstract

Accurate initial interpretations of brain computed tomography scan (CTs) by internists and primary care physicians remain critical in decision-making and the resulting quality of care. To determine the accuracy of interpretation of brain CTs by internists in radiology department after official hour periods at the HRH Princess Maha Chakri Sirindhorn Medical Center in Nakhon Nayok, Thailand. Between January 2011 and December 2012, 125 brain CTs imagings were requested, initially interpreted by internists and reviewed by 2 experienced radiologists. Compared interpretation results were calculated. Accurate percentages of brain CTs interpretation in ischemic stroke, intracranial hemorrhage, skull or facial fracture, intracranial mass, hydrocephalus, and brain herniation were 80.8%, 91.2%, 96.8%, 99.2%, 92%, and 92.8%, respectively. The numbers of patients in agreement interpretation were 83 (66.4%) in the agreement (AG) group, 27 (21.6%) in the disagreement significant (DS) group, and 15 (12.0%) in the disagreement insignificant (DI) group. Most interpretations of brain CTs done by the internists had shown a poor sensitivity but a high specificity. In conclusion, low accuracy of brain CTs interpretations by internists after official hour were in cases of ischemic stroke. Education in brain CTs interpretations for internists is necessary for improving the quality of treatment.

Keywords: accurate interpretation, brain CTs, internists

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Introduction

Brain Computer Tomography scans are now available in many medical centers. It has shown high accuracy and an improvement in the quality of imaging. In radiology department after official hour periods, a CT-brain is requested more often for diagnosis than the imaging of other organs by internists or emergency medicine doctors. Initial accurate interpretations of CTs of the brain by internists remains critical for decision-making and the resulting quality of care. Nee Chen Khoo et al reported the accuracy, sensitivity and specificity of emergency medicine and other department doctors in interpretation of CTs of the brain without contrast in 287 imagings were 67%, 57% and 70%, respectively[1] Wysoki et al, reported that radiology residents accuracy of interpretation were not different, statistically, when compared with experienced radiologists and in no instances were the management or outcomes for these patients affected[2]. However, several studies have shown different accuracy rates in interpretations of brain CTs.

Objective

To evaluate the accuracy of interpretations of brain CTs by internists after official hour periods at the HRH Princess Maha Chakri Sirindhorn Medical Center.

Materials and Methods

Between January 2011 and December 2012, 125 brain CTs imagings in radiology department after official hours were requested by internists. We collected data on prospective study by brain CTs interpretation form about interpretations and diagnoses. All of the imagings data were categorized as ischemic stroke, intracranial hemorrhage, skull or facial fracture, intracranial mass, hydrocephalus, and brain herniation groups. All brain-CTs imagings were reviewed and diagnosed by 2 experienced radiologists in consensus. Radiologists were blinded to the interpretation results of the internists. Inclusion criteria was all brain-CTs imagings done after official hour periods. Exclusion criteria included any previous brain-CTs diagnoses done by any other radiologists.

Interpretation and categorized data

Accurate interpretation was calculated in each category of abnormal brain CTs. False negative lesions were assessed. Comparative interpretations of brain-CTs imaging data between internists and radiologists were categorized as; in agreement (AG), disagreement-significant (DS) and disagreement-insignificant (DI). Agreement was categorized when there were no mistakes in the interpretation done by internists. Disagreement-significant was the result when gross error led to missed diagnoses. Disagreement-insignificant was defined as a minor error leading to a missed diagnosis.

Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and the accuracy of interpretation values were calculated for each disease.

Results

One hundred and twenty five images, non-contrast enhanced brain CTs, were categorized as their abnormalities (Table 1).

Table 1 Abnormalities of brain-CTs

Category	Number of abnormalities	Percentage of abnormalities (N=125)
Ischemic stroke	30	24.0
Intracranial hemorrhage	21	16.8
Skull or facial fracture	7	5.6
Intracranial mass	6	4.8
Hydrocephalus	4	3.2
Brain herniation	7	5.6
Total	75	60.0

Ischemic strokes and intracranial hemorrhages were the first and the second most common abnormalities seen in emergent CTs of the brain. The highest accuracy in interpretations of brain-CTs was in intracranial mass (99.2%) and the lowest accuracy was in ischemic strokes (80.8%). Accurate percentages of brain-CTs interpretation in each category is shown in Figure 1.

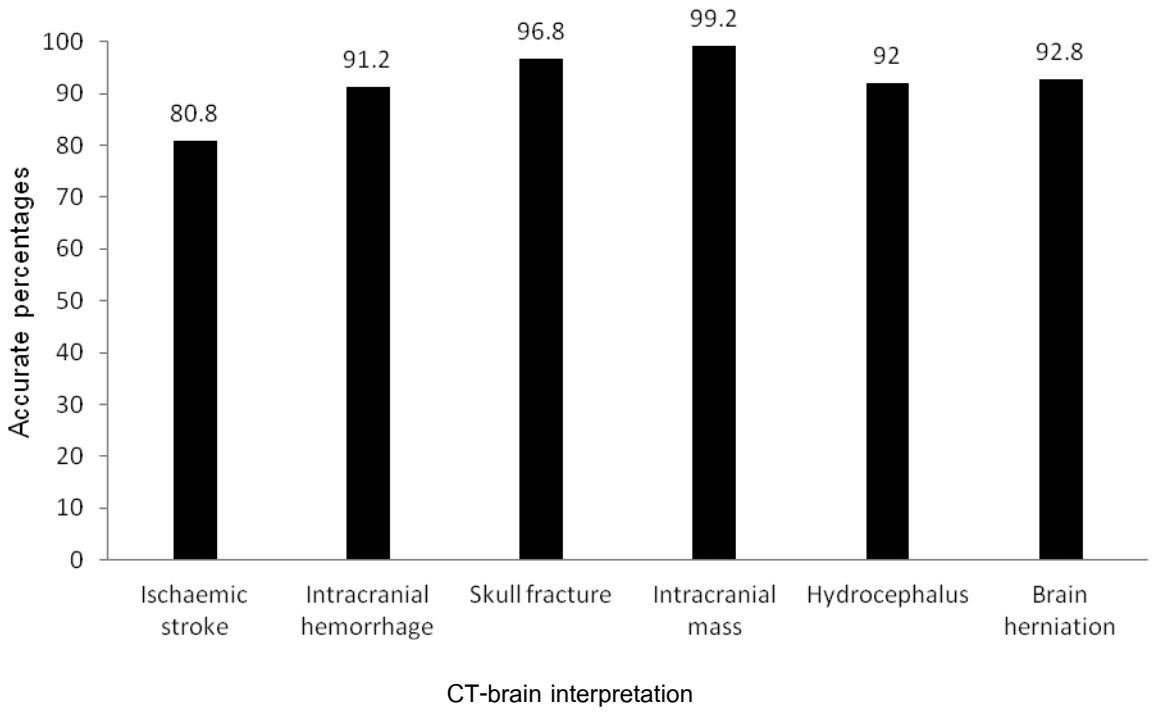


Figure 1 Accurate percentages of CT-brain interpretation by internists, (Total number: N=125).

False negative lesions consist of 41 results; 20 ischemic strokes, 8 intracranial hemorrhages, 4 skull or facial fractures, 1 intracranial mass, 2 hydrocephalus patients and 6 instances of brain herniation. Details of false negative lesions are shown in Table 2.

Table 2 False negative lesions in each category (SDH = subdural hematoma, and SAH = subarachanoid hemorrhage).

Abnormal Findings	Total Number	Details of abnormal
Ischemic stroke	20	Hyperacute infarction Lacunar infarction at pons Lacunar infarction at thalamus Lacunar infarction at basal ganglion Lacunar infarction at temporal lobe
Intracranial hemorrhage - Extracerebral hemorrhage - Intracerebral hemorrhage - Intraventricular hemorrhage	8 4 3 1	 SDH, SAH Frontal lobe, Occipital lobe hemorrhage

Table 2 (continue)

Abnormal Findings	Total Number	Details of abnormal
Skull or facial fracture	4	Multiple facial bone, base of skull
Intracranial mass	1	
Hydrocephalus	2	
Brain herniation	6	Subfalcine, uncal, transtentorial

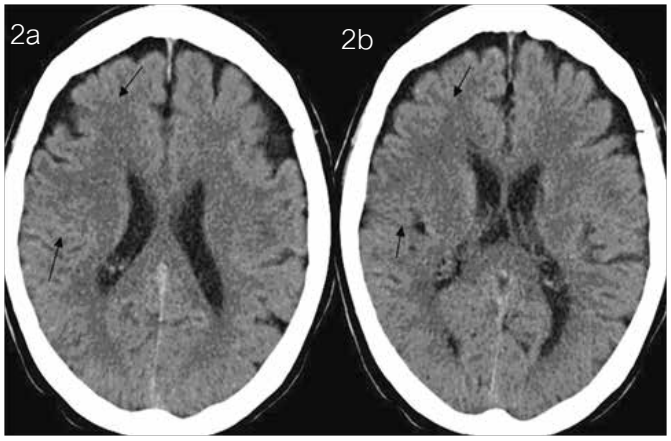


Figure 2 Axial CT images of 76-year-old female with left sided weakness
2a) and 2b) Acute infarct at right frontal lobe is visible as right frontal hypoattenuating gray matter and hypoattenuating white matter, with associated sulcal effacement (black arrows).

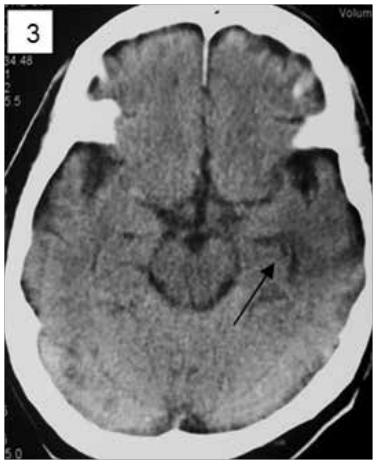


Figure 3 Axial CT scan shows ill-defined hypoattenuation at left temporal lobe with sulcal effacement, compatible with acute infarction.

Figure 4 Axial CT scan shows acute lacunar infarction at right side of pons (black arrow).

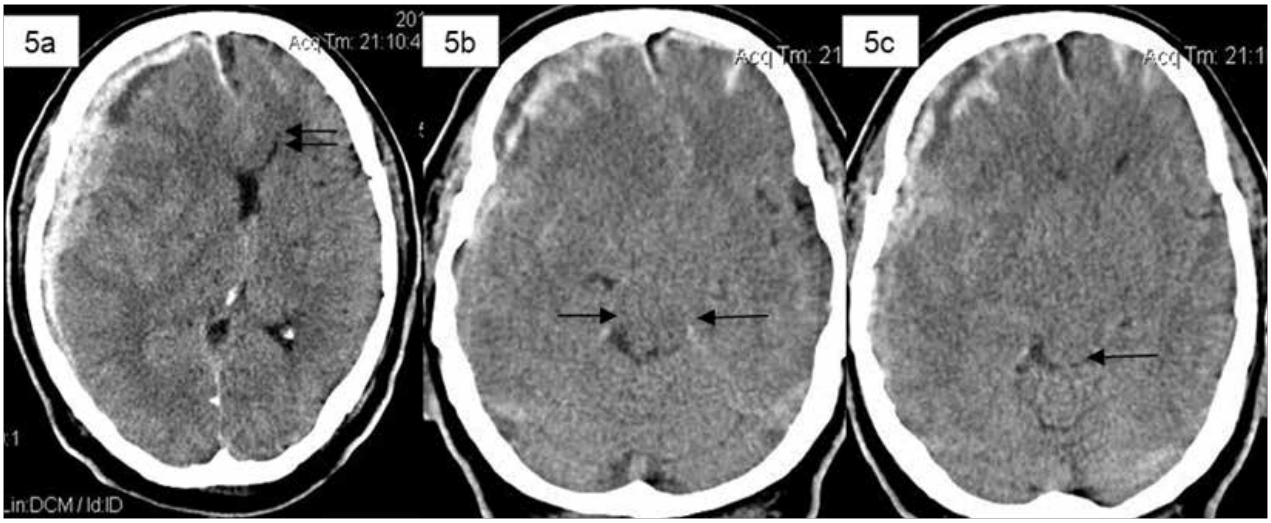


Figure 5 Axial CT scan of acute subdural hematoma along falx cerebri, transtentorial cerebelli, right frontotemporal convexity and diffuse subarachnoid hemorrhage. It shows false-negative finding involving brain herniation.
a) Subfalcine brain herniation b) Bilateral uncal brain herniation
c) Descending transtentorial brain herniation

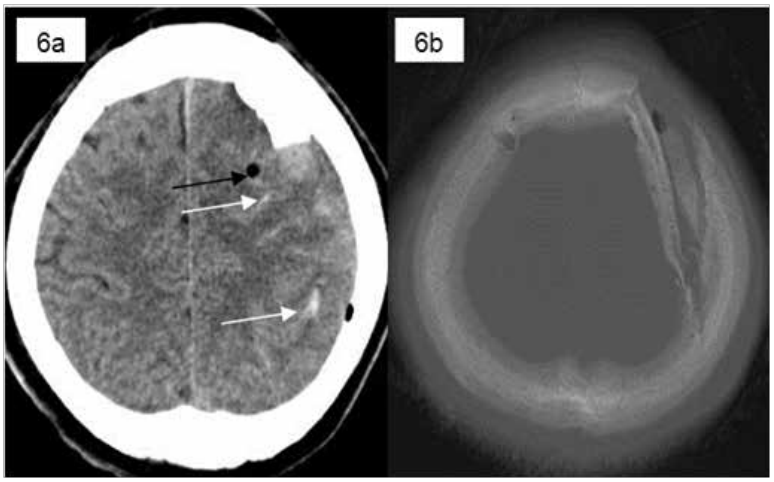


Figure 6 Axial CT scan brain window (6a) and bone window (6b).
6a) Acute subarachnoid hemorrhage along high left frontoparietal sulci (white arrows) and minimal pneumocephalus at left frontoparietal region (black arrow).
6b) Depressed skull fracture at left frontoparietal bone.

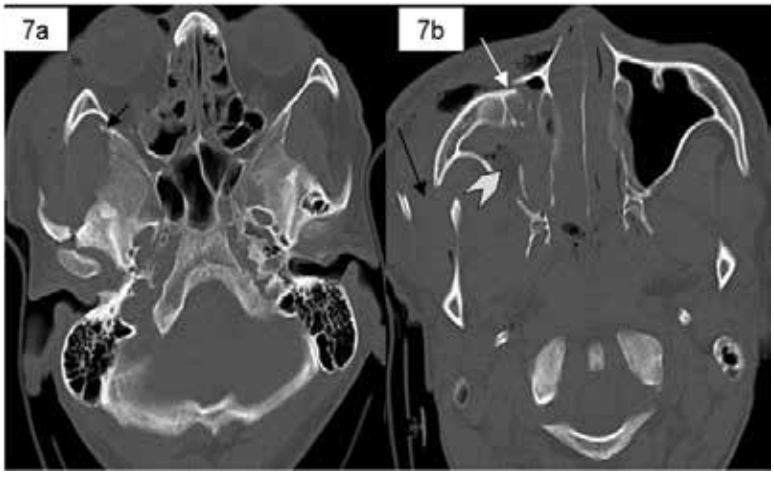


Figure 7a and 7b Contiguous 5-mm axial CT scans bone window demonstrate multiple bony fractures at right zygomatic arch (black arrow), anterolateral bony wall of right maxillary sinus (white arrow), right maxillary hemosinus (white arrowhead), and greater wing of right sphenoid bone (short black arrow).

The percentage of agreement interpretation in detection of abnormal CTs of the brain were 83 (66.4%) in the agreement group, 27 (21.6%) in the disagreement-significant group and 15 (12.0%) in the disagreement-insignificant group.

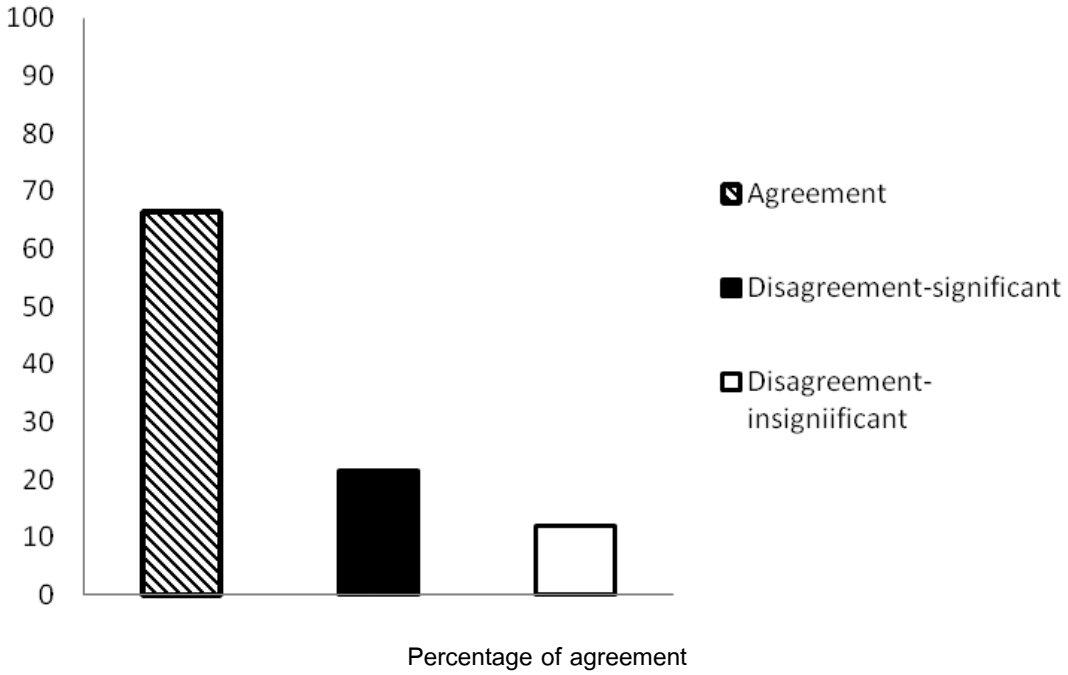
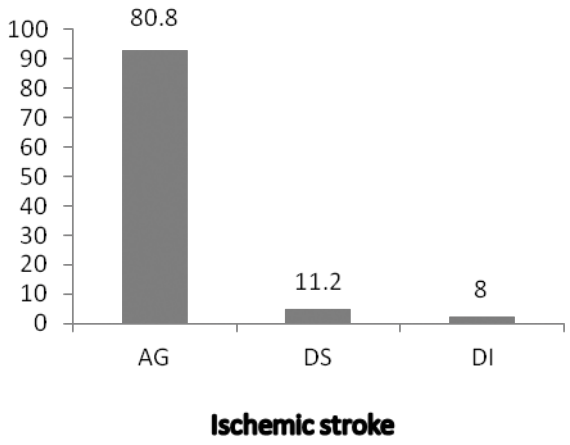
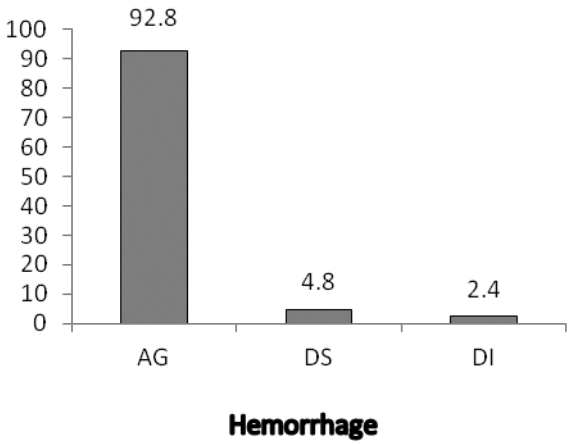


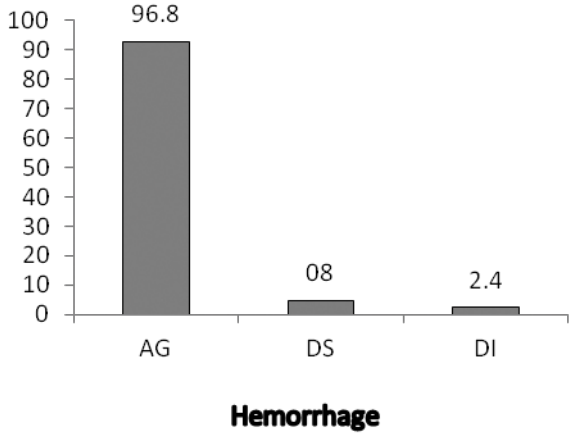
Figure 8 Percentages of agreement interpretation by internists compared with radiologists (N=125).

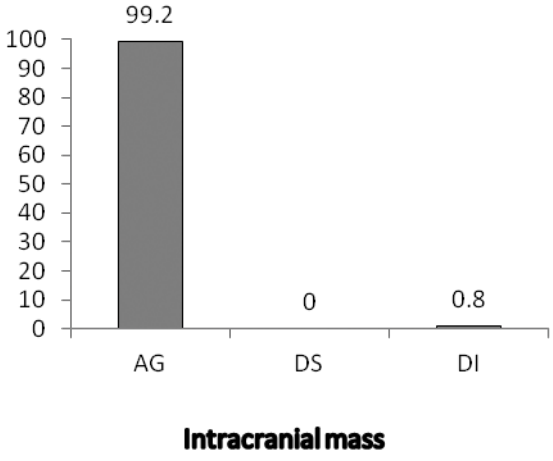
Table 3 Shows sensitivity, specificity, PPV, and NPV in interpretation of CT-brain.

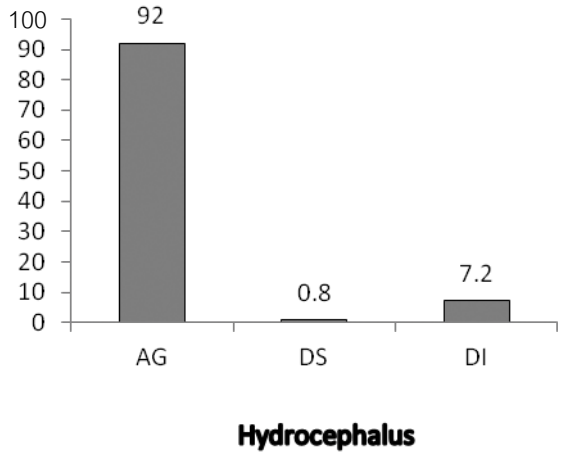
	Intracranial hemorrhage N=30	Ischemic stroke N=21	Skull / facial fracture N=7	intracranial mass N=6	Hydroceph-alus N=7	Brain herniation N=4
Sensitivity (%)	61.9	33.3	42.9	83.3	50.0	33.3
Specificity (%)	91.7	95.7	100	100	93.3	97.4
PPV (%)	81.3	71.4	100	100	25.0	50.0
NPV (%)	92.7	82.0	96.7	99.1	98.3	95.0
Accuracy (%)	91.2	80.8	96.8	99.2	92.0	92.8











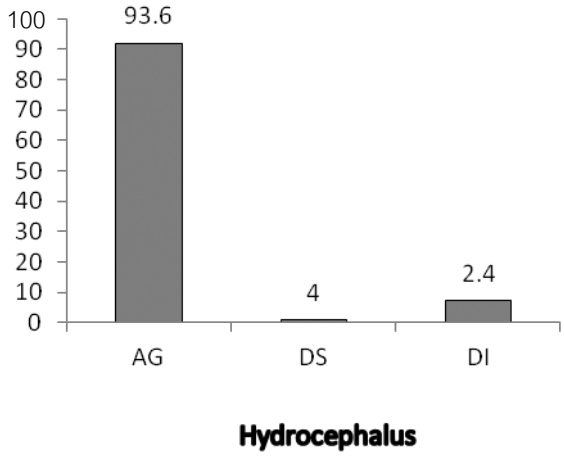


Figure 9 Percent of agreement in each category.

The highest PPV were in skull and facial bone fractures and intracranial mass and the lowest PPV was shown in hydrocephalus. The lowest NPV was in ischemic stroke. Sensitivity, specificity, NPV, and PPV of interpretation of CT-brain are calculated and are shown in Table 3.

Discussion

CTs of the brain are now available in several centers. Accurate interpretation is crucial for the initial management and for good results of the patients' care. Several studies had shown different accuracy rates in interpretations of brain-CTs.[3-5] Our study has shown high accurate interpretations by internists especially in interpretations of intracranial hemorrhages, skull fractures, intracranial mass, and brain herniation. But there is an exception in reading ischemic stroke. In the category of ischemic stroke, there is a high disagreement-significant value up to 18.7%. However, the other categories of abnormalities have shown little disagreement-significance. The category of ischemic stroke has the highest disagreement-significance which may be a result of low accuracy in interpretation. False negative in all categories are shown same results in other studies, especially in ischemic stroke and intracranial hemorrhage.[6] The low accuracy in diagnosing ischemic stroke may be the result of inexperienced internists who interpreted emergency brain-CTs by internists. This result should be concerned when caring for emergency patients. It may be harmful to discharge patients without treatment. Our study has shown the same sensitivity results as have been seen in other studies. Heng RC and Bell KW[7] showed that radiology trainees recorded a significantly higher sensitivity when compared to other doctors when interpreting urgent CT scans. Most abnormalities interpreted by internists had a poor sensitivity but a high specificity. We recommend the additional course for educating internists in CT-brain interpretation for improving the quality of emergency health care patients.

Conclusions

The lowest accurate interpretation of brain-CTs by internists at the emergency room after official hours was in ischemic strokes which mostly were subtle lesions. There should be the requirement for development the further teaching medical staffs to improve the accuracy of imaging interpretation.

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