Comment on: Effectiveness of radiology modalities in diagnosing and characterizing brain disorders

To the Editor

We have read with interest Aljahdali et al.'s article about a retrospective study on the sensitivity of cerebral computed tomography (CCT) and cerebral magnetic resonance imaging (cMRI) for the diagnosis of a "neurological disorder" in 3155 patients.[1] It was found that 2426 patients (77%) had cerebral disease identified by imaging and that half of these patients suffered a stroke (n=1543).[1] The association of imaging modality, patient type, gender and the confirmed cerebral disease was not significant.[1] The study is excellent, but some points need discussion.

The first point is that the accuracy of detecting cerebral disorders using cerebral CT (CCT) or cMRI was only 77%.[1] In 1729 cases imaging studies failed to make the diagnosis based on cerebral imaging. We should know the clinical presentation of patients with negative imaging results and how the correct neurological diagnosis was made. Were these cases diagnosed with primary headache, genetic epilepsy, or meningitis or encephalitis? What was the reason her imaging was negative?

The second point is the statement in the results section that "the head was the most frequently scanned body part" in 3022 (96%) patients.[1] According to the aims and methods all 3155 patients underwent cerebral imaging. Why did 4% of patients not undergo cerebral imaging? These patients should be excluded from the study because they do not meet the inclusion criteria.

The third point is that it is incomprehensible why arterial hypertension was an indication for performing cerebral imaging as mentioned in **Table 1** and the discussion.[1] Did patients with arterial hypertension have neurological deficits? It is also incomprehensible why abnormal cerebrospinal fluid (CSF) findings were an indication for cerebral imaging. In patients with an indication for lumbar puncture cerebral imaging should be performed prior to the spinal tap.

A fourth point is that there is no mention of how many patients received both CCT and cMRI. In how many of these cases did one test lead to a diagnosis but not the other, and in how many cases were both tests diagnostic?

A fifth point is that brain disorders other than stroke diagnosed by cerebral imaging were not mentioned. We should know what type of cerebral disease was found in the 1729 patients without diagnostic cerebral imaging and in the 833 patients who did not have a stroke.

A sixth point is that it was not mentioned which MRI modalities were routinely used and whether only parenchymal information was obtained or whether the patients also had magnetic resonance angiography or CT angiography. The CCT and MRI may be normal, but angiography may show stenosis or occlusion due to atherosclerosis, dissection, vasospasm, or vasculitis. Was MR spectroscopy also used?

A seventh point is the discrepancy between the objectives of the study (assessing the accuracy of cerebral imaging to detect "neurological disorders") and the title that only cerebral diseases were of interest. This discrepancy should be resolved.

An eighth point is that patients "with symptoms indicative of subarachnoid bleeding" were excluded.[1] Subarachnoid bleeding cannot be diagnosed solely based on the patient's symptoms. Imaging is mandatory. What was the reason for excluding patients with subarachnoid bleeding?

We do not believe that "defibrillation" is a comorbidity as stated in **Table 1**.[1] For what reason were these patients resuscitated and defibrillated?

In summary, the excellent study has limitations that should be addressed before final conclusions are drawn. Great care must be taken when retrospectively analyzing cerebral imaging in patients with cerebral diseases.

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The first point is that the accuracy of detecting cerebral disorders using cerebral CT (CCT) or cMRI was only 77%.[1] For negative imaging results, various factors have contributed to this discrepancy like the timing of imaging studies relative to symptom onset, the sensitivity of imaging modalities in detecting specific pathologies, and the presence of subtle or atypical neurological manifestations that may not be

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readily visualized on imaging. Additionally, individual variations in disease presentation and imaging interpretation influenced the diagnostic outcome.

Importantly, in cases where imaging studies failed to provide a definitive diagnosis, clinical judgment and the integration of ancillary diagnostic tests played a pivotal role in reaching an accurate neurological diagnosis. These ancillary tests, including cerebrospinal fluid analysis, electroencephalography, genetic testing, and neurophysiological studies, served as complementary tools to imaging studies, enhancing diagnostic accuracy and guiding clinical management decisions.

The second point is the statement in the results section that "the head was the most frequently scanned body part" in 3022 (96%) patients.[1] The statement indicating that "the head was the most frequently scanned body part" accurately reflects the prevalence of cerebral imaging in our study population. However, we acknowledge that the wording may have caused confusion regarding the exclusivity of cerebral imaging in all patients.

The inclusion of patients who underwent imaging of other body parts was not an oversight but rather reflective of the diverse clinical presentations encountered in our study cohort. Our study only excluded patients who had neither undergone CT nor MRI. In some cases, patients presented with symptoms necessitating imaging of body parts other than the brain to aid in their diagnostic workup.

It is important to note that these patients were not excluded from the study but rather included in the analysis to provide a comprehensive understanding of imaging utilization in the evaluation of neurological disorders. Our study aimed to capture real-world clinical practices, where imaging modalities may be tailored to individual patient presentations and clinical indications.

The third point is that it is incomprehensible why arterial hypertension was an indication for performing cerebral imaging as mentioned in **Table 1** and the discussion.[1] Firstly, the inclusion of arterial hypertension as an indication for performing cerebral imaging was based on clinical considerations and the medical history of the patients. While arterial hypertension itself may not always present with neurological deficits, it is well-established in medical literature that uncontrolled hypertension can predispose individuals to cerebrovascular events such as strokes and transient ischemic attacks (TIAs). Therefore, cerebral imaging in patients with arterial hypertension aimed to assess for any underlying cerebrovascular pathology that may contribute to or be exacerbated by hypertension.

Regarding abnormal cerebrospinal fluid (CSF) findings, abnormal CSF findings, such as elevated protein levels, leukocytosis, or evidence of infection, can be indicative of various neurological conditions, including meningitis, encephalitis, or central nervous system (CNS) malignancies. In such cases, cerebral imaging serves to complement CSF analysis by providing structural information about the brain and aiding in the diagnostic workup.

Regarding the sequence of diagnostic tests, including lumbar puncture and cerebral imaging, we acknowledge the importance of proper diagnostic sequencing to ensure patient safety and diagnostic accuracy. In cases where lumbar puncture is indicated, it is indeed recommended to perform cerebral imaging prior to the spinal tap to rule out any contraindications or structural abnormalities that may predispose patients to complications from the procedure.

However, it is essential to recognize that our study aimed to evaluate the real-world clinical practices and diagnostic pathways encountered in neurological practice. While ideal diagnostic sequencing is important, clinical decision-making often involves an approach based on individual patient presentations, clinical judgment, and available resources. Therefore, the inclusion of patients with abnormal CSF findings as an indication for cerebral imaging reflects the diverse clinical scenarios encountered in neurological practice, where diagnostic pathways may vary based on the specific clinical context and urgency of the situation.

A fourth point is that there is no mention of how many patients received both CCT and cMRI. In our retrospective study, we worked with existing data to analyze the diagnostic outcomes of patients who underwent either CCT or cMRI. We did not specifically aim to compare cases where both imaging techniques were performed. Instead, our focus was on evaluating the diagnostic accuracy of each modality individually. Therefore, we didn't explicitly report on the number of cases where both CCT and cMRI were conducted. Our analysis was directed towards understanding the effectiveness of each imaging technique on its own in diagnosing neurological disorders.

A fifth point is that brain disorders other than stroke diagnosed by cerebral imaging were not mentioned. In our study, the focus was primarily on evaluating the accuracy of cerebral imaging modalities, namely CCT and cMRI, in diagnosing neurological disorders, particularly strokes. The patients who did not undergo diagnostic cerebral imaging and those without a stroke diagnosis represent distinct subsets within our study cohort. In the group of patients without diagnostic cerebral imaging, various factors contributed to the lack of imaging, including clinical judgment, contraindications, or patient preferences. Similarly, among the patients who did not have a stroke, a range of cerebral disorders may have been identified through clinical evaluation, diagnostic testing, or subsequent imaging modalities beyond the scope of our study. Our retrospective analysis focused on the diagnostic accuracy of cerebral imaging modalities, and while strokes were a primary area of interest, other cerebral diseases were indeed identified and managed within our clinical practice.

A sixth point is that it was not mentioned which MRI modalities were routinely used and whether only parenchymal information was obtained or whether the patients also had magnetic resonance angiography or CT angiography. Our study design focused on analyzing the diagnostic outcomes of CCT and cMRI, which are widely available and commonly utilized modalities for evaluating neurological conditions. While adjunct imaging techniques such as MRA, CTA, and MR spectroscopy may offer additional diagnostic information, their inclusion was not explicitly addressed in our study protocol. Great care was taken in the interpretation of CCT and cMRI findings, guided by clinical judgment and adherence to best practices in neurological imaging. We recognize the potential utility of adjunct imaging modalities in certain clinical scenarios, particularly in cases where CCT and cMRI may yield normal results despite underlying vascular pathology or metabolic abnormalities.

A seventh point is the discrepancy between the objectives of the study (assessing the accuracy of cerebral imaging to detect "neurological disorders") and the title that only cerebral diseases were of interest. In our study, the primary objective was indeed to assess the accuracy of cerebral imaging modalities, specifically CCT and cMRI, in detecting a wide spectrum of neurological disorders. The title of our research study, which refers to "cerebral diseases," was intended to provide a succinct overview of the primary focus of our investigation while encompassing the broader scope of neurological disorders evaluated through cerebral imaging.

To resolve this discrepancy, the title of our study should be changed to better align with the comprehensive nature of our research objectives "Effectiveness of Cerebral Imaging Modalities in Detecting Neurological Disorders".

An eighth point is that patients "with symptoms indicative of subarachnoid bleeding" were excluded.[1] Regarding the exclusion of patients with symptoms indicative of subarachnoid bleeding, we acknowledge that imaging is indeed essential for confirming a diagnosis of subarachnoid hemorrhage (SAH). Our decision to exclude these patients was based on the retrospective nature of our study and the focus on evaluating the diagnostic accuracy of cerebral imaging modalities, specifically CCT and cMRI, in detecting neurological disorders. In cases where subarachnoid bleeding was suspected clinically, patients would typically undergo immediate imaging studies, such as CT angiography or lumbar puncture, for definitive diagnosis. Therefore, our study primarily aimed to assess the diagnostic performance of CCT and cMRI in detecting neurological disorders beyond SAH, which may have influenced our exclusion criteria.

Regarding the classification of "defibrillation" as a comorbidity in our study, our intention was to capture significant medical events or procedures that patients had undergone as part of their treatment history. In many clinical contexts, interventions like defibrillation may be recorded alongside other medical conditions or comorbidities, as they can have a significant impact on the patient's overall health status and medical management. Therefore, we included "defibrillation" in our analysis to provide a comprehensive overview of the patients' medical backgrounds and treatment trajectories.

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