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Assessment of the low-field magnetic resonance imaging for the brain scan imaging of the infant hydrocephalus

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ABSTRACT

Objective: In today's global clinical settings, low-field magnetic resonance imaging (MRI) technology is becoming increasingly prevalent. Ensuring high-quality image acquisition is crucial for accurate disease diagnosis and treatment and for evaluating the impact of poor-quality images. In this study, we explored the potential of deep learning as a diagnostic tool for improving image quality in hydrocephalus analysis planning. This could include discussions on the diagnostic accuracy, cost-effectiveness, and practicality of using low-field MRI as an alternative.

Methods: There are many reasons which are going to affect infant computed tomography images. These are spatial resolution, noise, and contrast between the brain and cerebrospinal fluid (CSF). Now, we can enhance using the application of deep learning algorithms. Both improved and down quality were situated to the three qualified pediatric neurosurgeons comfortable with working in poor- to middle-level [illegible] treatment of hydrocephalus.

Results: The results [illegible] beneficial for hydrocephalus treatment planning, according to image resolution and the contrast-to-noise ratio (CNR) between the brain and CSF. The CNR is significantly improved by deep learning enhancement, which also improves the apparent likelihood of the image.

Conclusion: However, poor-quality images might be desirable to image improved by deep learning, since those images will not offer the risk of confusing facts which could misguide the decision of the analysis of patients. Such findings support the newly introduced measurement standards in estimating the acceptable quality of images for clinical use.

Keywords: Brain imaging, comparative modeling, deep learning, hydrocephalus, neuroimaging

Introduction

Childhood hydrocephalus is the most frequent pediatric illness needing neurosurgery globally, with an estimated 400,000 new cases each year.[1] The majority of incidents, more than 90%, occur in LMICs, or low-and middle-income countries.[1] The disease affects over 180,000 infants in sub-Saharan Africa each year.[2-4] In newly born with hydrocephalus, the head enlarges due to an accumulation of intracranial cerebrospinal fluid (CSF). To arrange surgery for these infants, intracranial imaging is necessary. Knowing where the CSF is located in the brain and how many loculated compartments where fluid is trapped is crucial for planning surgery. It is necessary to have imaging technology that can accurately depict the contrast between the brain and CSF. We earlier suggested that a voxel size approaching 100 mm^3 (eg. $3 \times 3 \times 10$ mm^3) could be enough to set treatment plans.[1]

The soft tissue and fluid that are contained in the skull can only be imaged to a limited extent on the brain. The acoustical windows of the fontanels are only open during the 1st year of life due to skull fusion; for this much, ultrasound is only effective. The risks associated with ionizing contamination from computed tomography (CT) scans for infants can vary depending on factors such as the dose of radiation, frequency of exposure, and the infant's age. Infants who undergo CT scans may be at higher risk of radiation-related complications due to their increased sensitivity to radiation, as their organs and tissues are still developing. The potential dangers may include an increased risk of developing cancer later in life, potential damage to developing organs, and an increased risk of other long-term health effects. Thus, the ionizing contamination associated with CT poses very high dangers to infants;[5] though, in the subarea of Saharan Africa, CT is more dominant than magnetic resonance imaging (MRI) (according to a 2011