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Best Practice Guideline Article

Ultrasound detection of posterior fossa abnormalities in full-term neonates

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ABSTRACT

Routine cranial ultrasonography, using the anterior fontanelle as acoustic window enables visualization of the supratentorial brain structures in neonates and young infants. The mastoid fontanelle enables a better view of the infratentorial structures, especially cerebellar hemorrhage in preterm infants. Reports on the usefulness and reliability of cranial ultrasonography using the mastoid fontanelle approach for the detection of posterior fossa abnormalities, focusing only on full-term neonates are limited.
This article describes the technique of mastoid fontanelle ultrasonography in full-term neonates and the features of posterior fossa abnormalities that may be encountered in various neonatal disorders and conditions, combined with subsequent MRI in the same patients. Cranial ultrasound through the mastoid fontanelle plays a pivotal role in the early detection of posterior fossa pathology and selection of neonates with an indication for MRI.

Contents

1. Introduction

Cranial ultrasonography (CUS) is a reliable and noninvasive tool for brain imaging during the neonatal period. It can be performed at the bedside and instantly provides useful diagnostic information to the clinician. It is traditionally performed through the anterior fontanelle (AF). This approach provides a good view of supratentorial structures, but visualization of infratentorial structures is suboptimal because of the distance from the transducer to the posterior fossa (PF). In addition, the echogenic tentorium and vermis impede the detection of lesions [1]. By using the

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mastoid fontanelle (MF) as an additional acoustic window, the transducer is positioned closer to the PF structures and approaches them at a different angle, avoiding the echogenic tentorium. Previous studies have stressed the advantages of CUS using the mastoid fontanelle approach (MF-CUS) for the detection of PF lesions in neonates [2–6]. Acquired lesions related to hemorrhage, infarction and infection are mostly described in preterm infants [3,4,6–9], while reports on the applicability of MF-CUS for the detection of PF abnormalities, focusing on full-term neonates are limited.

The more widespread use of magnetic resonance imaging (MRI) has led to an increased detection of cerebellar injury in the high risk full-term neonate. Especially larger cerebellar lesions are associated with a broad spectrum of neurodevelopmental disabilities [10–12].

The aim of this paper is to describe CUS abnormalities of the PF in full-term neonates that may be encountered in various neonatal disorders and conditions such as hypoxic–ischemic encephalopathy (HIE), central nervous system (CNS) infections, intracranial hemorrhage, inborn errors of metabolism and congenital PF malformations. This is illustrated in several cases, showing the characteristics as seen on MF-CUS and MRI. The applicability and the pitfalls and limitations of the MF approach are discussed.

2. Imaging the posterior fossa: technical aspects

2.1. CUS procedure

Cerebellar injury can occur in several conditions, including HIE, CNS infections, traumatic delivery, supratentorial hemorrhage, and inborn errors of metabolism [4,10–12]. In these conditions MF-CUS may be helpful for the detection of PF abnormalities. In addition, congenital malformations of the PF may be better depicted when the MF is used [4,11]. A high resolution, real-time, 2D ultrasound machine with special settings for the newborn infants' brain and with a multi frequency transducer or different frequency transducers (5, 7.5, 10 MHz) should be used. The transducer should be small enough to fit the MF window [1,5].

The technique of MF-CUS has previously been described in detail [1,4,5]. The MF is located at the junction of the posterior parietal, temporal and occipital bones [3]. The infant is positioned with the head to one side, and the transducer is placed over the MF, behind the helix of the ear, just above the tragus. The transducer is then slightly moved and rotated until an appropriate view of the PF is obtained. Images can be performed in axial and coronal orientations, from superior to inferior, and provide detailed visualization of the cerebellum (vermis and hemispheres), 4th ventricle, aqueduct and cisterna magna. Fig. 1 shows examples of normal CUS images in axial and coronal planes, obtained through the MF in a full-term neonate.

2.2. MRI procedure

MRI should be performed in all neonates with clinical or CUS suspicion of parenchymal brain abnormalities. Technical aspects, scanning protocols, and sequences used in neonates have been reported [13]. The MRI protocol used for the images in this paper included T_1 3D turbo field echo (TFE) and T_2 turbo spin echo (TSE), T_2^* fast field

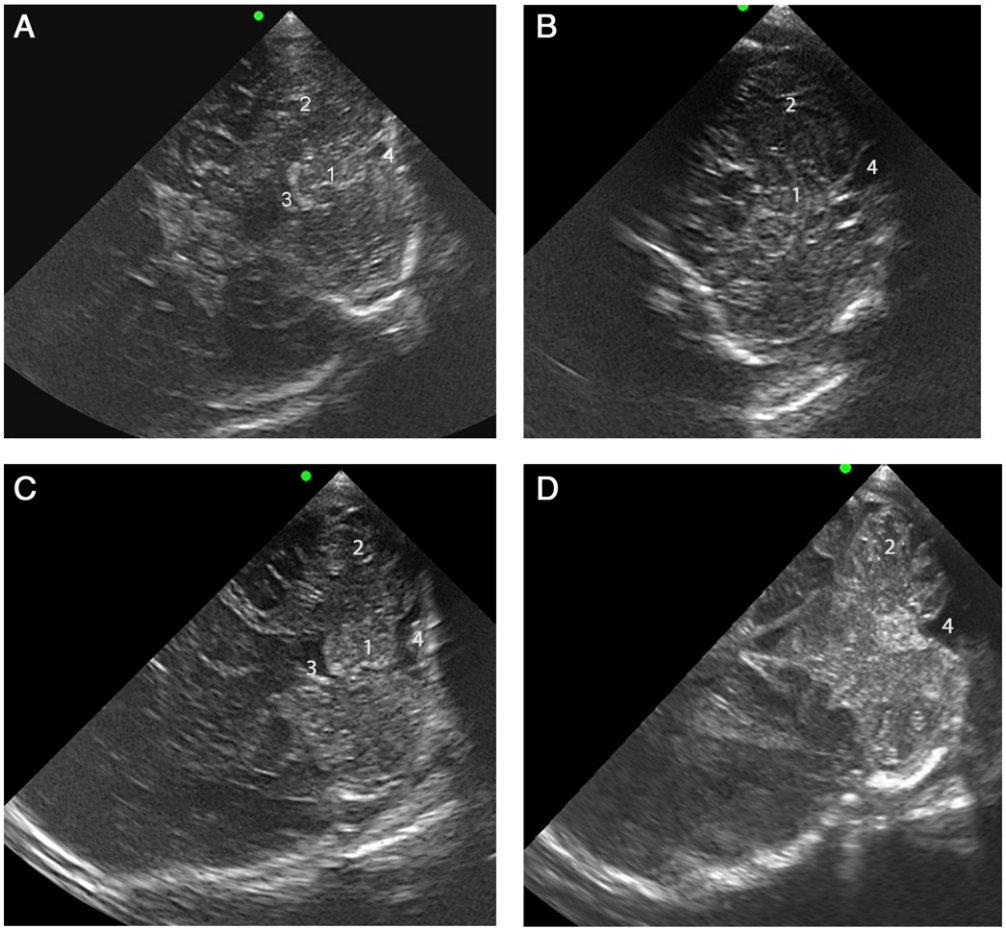

Fig. 1. Normal ultrasound scan in full-term neonate using the MF as acoustic window. A and B: Axial views, with A middle and B inferior view. C and D: Coronal views with C middle and D posterior–inferior view. Vermis (1), cerebellar hemisphere (the hemisphere located closest to the transducer is visualized in the upper part of the image) (2), 4th ventricle (3), cisterna magna (4). Note the subtle differences in echogenicity and anatomical details between the two hemispheres, due to differences in distance from the transducer.