Clinical Imaging 39 (2015) 1–8

Contents lists available at ScienceDirect

Clinical Imaging

journal homepage: http://www.clinicalimaging.org

Review Article

Diagnostic imaging of posterior fossa anomalies in the fetus and neonate: Part 1, normal anatomy and classification of anomalies ☆

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ARTICLE INFO

Article history:
Received 1 August 2014
Received in revised form 1 October 2014
Accepted 16 October 2014

Keywords:
Posterior fossa
Prenatal
Pediatric
Congenital
Fetal MRI

ABSTRACT

This article is the first portion of a two-part review that illustrates the normal appearance of the cerebellum and posterior fossa on prenatal ultrasound and MRI and on postnatal diagnostic imaging studies. Classification and terminology of posterior fossa abnormalities in the literature are confusing due to evolution of concepts and sometimes lack of consensus. Accurate classification of posterior fossa anomalies is important for predicting fetal outcome and for appropriate counseling. In Part 1 of this review, prenatal and postnatal imaging techniques for assessing the posterior fossa will be discussed, followed by a discussion of how cerebellar malformations may be classified.

1. Introduction

The cerebellum is one of the earliest structures to develop; however, its development is protracted and continues into the first few postnatal months [1–3]. An awareness of its evolving structure enables more accurate recognition of a broad spectrum of abnormalities. With advances in both fetal ultrasound and magnetic resonance imaging, abnormalities of the cerebellum and posterior fossa are being increasingly diagnosed prenatally, allowing providers to anticipate management issues at the time of delivery and during early infancy and also to help the parents in comprehension of the prognosis.

Multiple posterior fossa malformations may occur either in isolation or in association with supratentorial anomalies [2,4,5]. In recent years, there have been changes in the terminology used and the description and mechanisms of the different entities, and therefore literature about this topic can be somewhat confusing [6,7]. It is essential to determine the type of posterior fossa malformation as accurately as possible, as it reflects the postnatal outcome and may guide efforts at detection of associated anomalies, both within and outside the CNS. Detection of a severe hindbrain malformation, for instance, merits offering amniocentesis for genetic evaluation, as well as a detailed ultrasound and/or fetal MRI evaluation to rule out CNS and non-CNS anomalies.

This review illustrates the normal appearance of the cerebellum and posterior fossa and discusses the imaging features of various anomalies of the cerebellum and posterior fossa with prenatal and postnatal correlation.

2. Imaging appearance of normal cerebellum

2.1. Prenatal sonographic features

Sonographic evaluation of the posterior fossa is a routine part of antenatal imaging. The biometry of the cerebellum, vermis and the cisterna magna is evaluated. During prenatal imaging with ultrasound, visualization in the axial plane is required to evaluate the cerebellum. The axial plane for imaging the cerebellum is inferior to the plane used for acquiring the biparietal diameter. On the axial plane image, the cerebellar hemispheres appear hypoechoic with intermittent echogenic stripes, which represent the folia, while the cerebellar vermis appears uniformly echogenic in the midline (Fig. 1) [2]. The cisterna magna is an anechoic space behind the cerebellum. Typically, thin septae in the paramedian location (the falx cerebelli) extend from the junction of the cerebellum and vermis to the inner table of the occiput, and these are appreciable in the axial plane as echogenic lines through the otherwise anechoic cisterna magna (Fig. 2). The cerebellar vermis is comprised of 10 lobules, although each lobule is not distinctly seen by ultrasound

☆ Funding: None.
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http://dx.doi.org/10.1016/j.clinimag.2014.10.010
0899-7071/

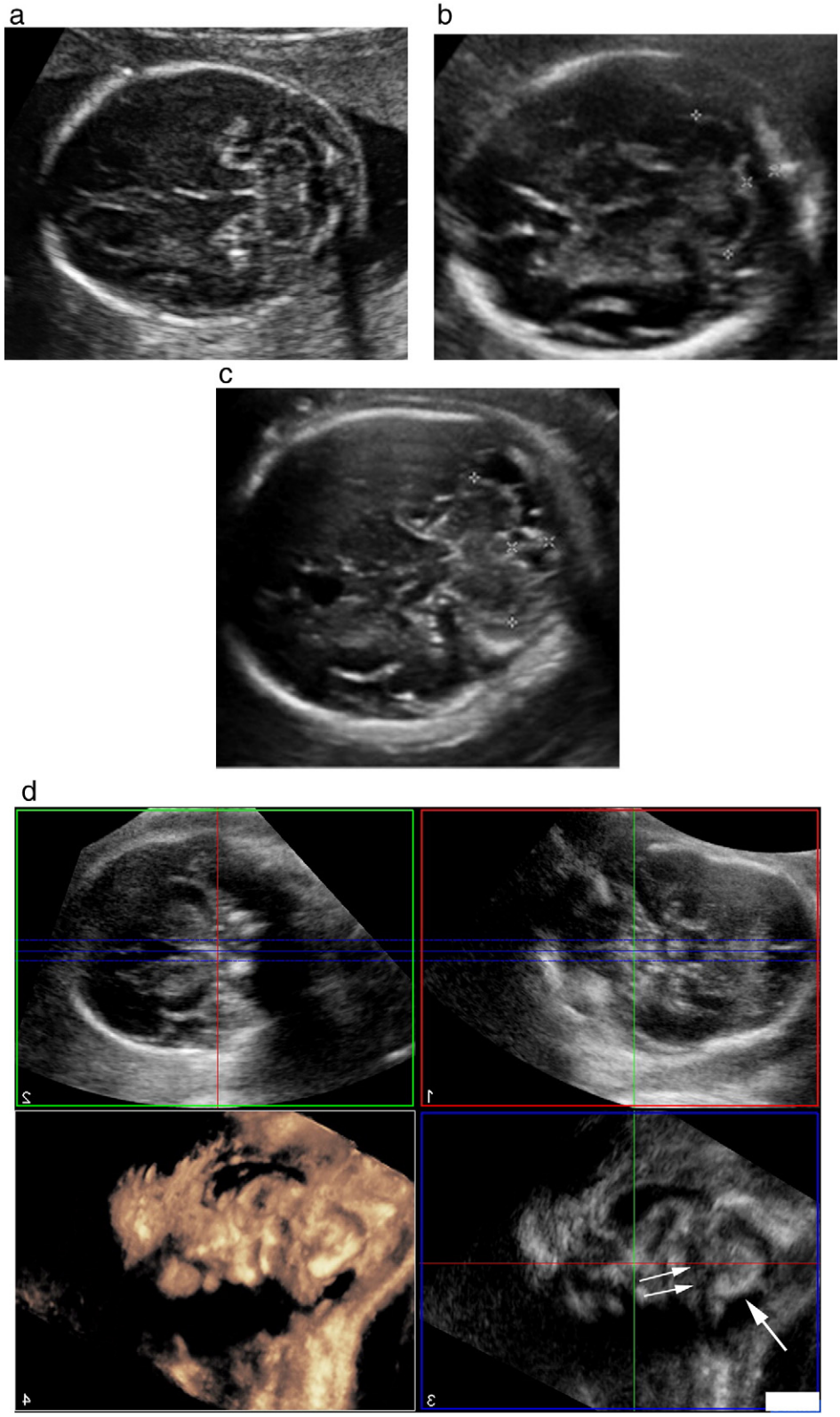

Fig. 1. Prenatal ultrasounds of three separate fetuses showing increasing conspicuity of the cerebellar folia. Note the progressively echogenic striped appearance of the cerebellum, related to development of the folia, as the gestational age increases from 20 weeks (*a*), to 24 weeks (*b*), and 28 weeks (*c*). Sagittal reformat from a 3-dimensional ultrasound of a 26-week gestational age fetus (*d*) shows a sagittal image of the normal vermis (arrow) and 4th ventricle (double arrow).

prenatally. Cerebellar vermian anatomy is more readily assessed by fetal MR imaging and will be discussed below (Section 2.2). Localization of the fourth ventricle echogenic choroid plexus should also be attempted, as absence or displacement of the choroid plexus may help in distinguishing various etiologies of abnormal posterior fossa fluid spaces (discussed in *Part 2*, *section 3*).

In addition to the axial plane, visualization of the cerebellar vermis in the mid-sagittal plane is helpful. Evaluation in the axial plane alone,