Residual Germinal Matrix Tissue Detected on High-Resolution Ultrasound in Very Premature Neonates

Poster No.: C-1666
Congress: ECR 2015
Type: Scientific Exhibit
Authors: K. Buch\(^1\), D. Podhaizer\(^2\), A. Tsai\(^2\), I. Castro-Aragon\(^2\);
\(^1\)Westborough, MA/US, \(^2\)Boston, MA/US
Keywords: Ultrasound, Paediatric, Obstetrics (Pregnancy / birth / postnatal period), Neuroradiology brain, Normal variants, Developmental disease
DOI: 10.1594/ecr2015/C-1666

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Aims and objectives

Germinal matrix (GM) hemorrhage is one of the most common comorbidities encountered in premature neonates which is routinely detected on head ultrasound (US) examinations (1-6). The identification of GM hemorrhage is made by the detection of increased echogenicity within the caudothalamic groove without intraventricular hemorrhage seen on ultrasound examination. There is a well defined evolution of germinal matrix hemorrhage seen in neonates with intraventricular hemorrhage and hydrocephalus and in some cases evolution to porencephalic cyst formation (2-6).

A well known entity in the literature is the regression of GM tissue in the fetal brain (7-8). Typically the germinal matrix resolves around 32 weeks of gestation and is therefore, not typically seen in neonates older than 32 weeks of gestation (7-8). Due to improvements in neonatal care, younger and younger neonates are surviving. We defined residual GM tissue as linear echogenicities within the floors of the lateral ventricles. There is considerable overlap in the imaging findings between premature neonates with residual GM tissue and small, subependymal GM hemorrhage. The appropriate distinction between residual GM tissue and hemorrhage is important for clinical management and risk stratification.

The purpose of this study was to retrospectively review US head examinations in premature neonates and their subsequent follow-up examinations to identify foci of residual GM tissue and to correlate these findings with gestational age and patient demographics.
Methods and materials

Patient Demographics
Following IRB approval, between September 2007 and December 2013, a total of 407 portable head US exam reports performed on preterm neonates ranging from 23 to 36 gestational weeks of gestation were retrospectively reviewed.

Imaging Protocol
Per our institutional protocol, routine portable ultrasound head screening is performed in all infants less than 37 weeks of gestation with weekly follow-up screening examinations performed until they reach 39-40 weeks of gestation. All portable head ultrasound examinations were reviewed the presence of residual GM tissue and GM hemorrhage. All head ultrasounds included a high-resolution sweep obtained with a linear transducer per our institutional protocol. US findings of linear echogenicities at the floor of the lateral ventricles which were self-limited, spontaneously resolved, and demonstrated no cystic evolution were classified as residual GM tissue. GM hemorrhage was categorized as non-linear echogenicity seen at the caudolthalamic groove, echogenicities that progressed to develop cystic evolution. Germinal matrix hemorrhages were classified into four categories by Burstein and Papile based on the extent of hemorrhage (9).

Clinical Record Review
Correlation between ultrasound examinations was made with information in the electronic medical records including gender, gestational age, singleton or twin gestation, neurologic symptoms, development of germinal matrix or intraventricular hemorrhage. The occurrence, demographics, and imaging features distinguishing residual GM tissue from hemorrhage were recorded.

Statistical Analysis
Statistical analysis was performed using basic descriptive statistics including a Fisher's exact test. A P-value less than 0.05 was considered statistically significant.
Results

Patient Demographics:

Of the total of 407 patients included in this study, there were 206 male patients and 198 female patients. Gestational ages ranged from 22 weeks of gestation up to 36 weeks of gestation with a distribution shown in Table 1. The majority of the patients included in this cohort were born at 31 weeks of gestation comprising a total of 64 patients (15.7%). A total of 148 patients were part of a twin gestation (36%) and 15 patients were part of a triplet gestation (3.7%).

Presence of residual GM tissue:

A total of 127 patients (31%) had the presence of residual germinal matrix per our imaging criteria. There was no sonographic evidence of residual germinal matrix tissues in patients less than 23 weeks of gestation. Only 3 patients of 127 patients with residual germinal matrix tissue had gestation ages of 35 weeks and older (2 patients born at 35 weeks gestation, 1 patient at 36 weeks of gestation). The majority of patients with residual germinal matrix tissue were born at 31 weeks gestation, as seen in 18 patients (14.2%). Examples of residual germinal matrix tissue are seen in Figures 1 and 2.

Presence of GM hemorrhage:

Evidence of GM hemorrhage was seen in a total of 172 patients (36.6% of the entire patient cohort). Of the 172 patients with evidence of GM hemorrhage demonstrated either by presence of hemorrhage detected on ultrasound or cystic evolution suggestive of prior germinal matrix hemorrhage, 48 patients were classified as initially having residual germinal matrix tissue (28%). The remaining 124 patients found of have sonographic evidence of GM hemorrhage had no pre-dating ultrasound findings of residual germinal matrix tissue (72%).

Correlations between residual GM tissue and GM hemorrhage:

When compared to preterm neonates without residual germinal matrix, there is no significant association between residual germinal matrix tissue and germinal matrix hemorrhages ($P=0.23$). There was also no significant association between residual germinal matrix and each grade of germinal hemorrhage ($P=0.09$ for grade 1, $P=1$ for grade 2, $P=0.5$ for grade 3, and $P=0.38$ for grade 4).
Fig. 1: Figure 1: 27 weeks of gestation female patient with linear echogenicity at the floor of the right ventricle (red arrow).

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**Fig. 2:** Figure 2: 28 weeks of gestation male. Linear echogenicity is seen at the floor of the right lateral ventricle. On serial ultrasound examinations this finding involuted and there were no porencephalic cystic lesions.

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Fig. 3: Table 1: Distribution of ages of patients with residual GM tissue detected on head ultrasound examinations

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Conclusion

Residual GM tissue may present as linear echogenicities at the floor of the lateral ventricles similar to GM hemorrhage, without cystic evolution and resolution within two weeks. There is no increased risk of GM hemorrhage, neurologic deficits, or increase in length of hospital stay compared to other premature patients.
Residual GM tissue is a benign finding seen on high-resolution US in 13% of premature patients at 23-29 weeks of gestation. Distinction between residual GM tissue and GM hemorrhage is important for risk stratification and prognosis.
References


