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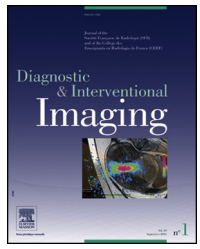

ORIGINAL ARTICLE / *Pediatric imaging*

Fetal skeletal computed tomography: When? How? Why?

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Abstract
Purpose: To study the additional role of fetal skeletal computed tomography in suspected prenatal bone abnormalities.
Materials and methods: Two centers included in a retrospective study all fetuses who benefited from skeletal computed tomography for a suspected constitutional bone disease or focal dysostosis.
Results: A total of 198 patients were included. CT was performed in 112 patients (56%) for an isolated short femur below the third percentile (group A), in 15 patients (8%) for bowed or fractured femur (group B), in 23 patients (12%) for biometric discrepancy between a short femur and increased head circumference (group C) and in 48 patients (24%) for suspected focal dysostosis (group D). CT was interpreted as normal in 126 cases (64%), i.e. 87% in group A, 0% in group B, 65% in group C and 25% in group D. When including only cases with postnatal or postmortem clinical and/or radiological confirmation was available, CT provided additional and/or more accurate information than ultrasound in 20% of cases in group A, 66% in group B, 30% in group C and 72% in group D. Sixty-seven percent of patients in whom CT was interpreted as normal were lost to follow-up.

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Conclusion: In isolated short femur, fetal skeletal CT is normal in the great majority of cases although protocolized follow-up of these babies is absolutely compulsory, as a large proportion is lost to follow-up. Fetal skeletal CT can confirm or improve imaging for the suspected diagnosis in suspected focal dysostosis or constitutional bone disease.

Fetal skeletal malformations are an extremely wide and heterogeneous group of disorders. They may be generalized, as in constitutional bone diseases (CBD), or affect one or more bony parts in focal dysostosis.

Prenatal diagnosis of most of these disorders is still very variable. Screening ultrasound with measurement of femoral length and assessment of femoral morphology can be used to screen for certain abnormalities. The French National Technical Prenatal Screening Ultrasound Committee guidelines also emphasize examination of the different limb segments, spine and cranium to diagnose skeletal dysostoses.

Investigation of the bony pelvis and assessment of the overall skeleton are the main limitations of two-dimensional and three-dimensional ultrasound, but several preliminary publications have shown these to be useful (computed tomography [CT] as well).

Our aim was to determine the additional role of fetal skeletal CT in the prenatal diagnosis of bone disorders in a large-scale study.

Materials and methods

Between September 2005 and October 2009, 198 patients referred to two university prenatal diagnostic centers in the same town for suspected bone disorders on two-dimensional ultrasound were included in the study. All of the patients included underwent ''diagnostic'' ultrasound, although because of the retrospective nature of the study and long inclusion period, not all measurements of all long bones other than the femur were found.

All had a fetal skeletal CT scan.

The ultrasound indications for the fetal CT were classified into four groups:

- group A: fetuses with isolated short femur below the 3rd percentile;
- group B: fetuses with a bowed or fractured femur;
- group C: cases of biometric discrepancy between a short femur below the 5th percentile and an increased head circumference over the 95th percentile;
- group D: ultrasound showed suspected focal dysostosis particularly of the vertebral or cranio-facial bones or extremities.

Fetal upper and lower poles were identified using a portable ultrasound instrument (VOLUSON I — GENERAL ELECTRICS), realizing an ultrasound scout view, and CT images were obtained using two devices (SIEMENS — definition 64 section and SIEMENS — definition double source —, SIEMENS MEDICAL SYSTEMS — ERLANGEN — GERMANY).

Collimation was 0.625 mm, with a kilovoltage of 100 and 120 kV depending on patient body morphology and 100 mAs was used in all cases.

The acquisition lasted an average of 10.2 seconds with the mother holding her breath and without any premedication.

CT results were formalized as a standard report also used for ultrasound in the reference centers in order to allow a strict comparison of the results.

CT results were classified as normal or abnormal, and if an abnormality was present, the reviewers (GG-MP) established whether the scan provided additional information and/or provided greater diagnostic accuracy as a result of improved image quality compared to two-dimensional ultrasound. Only cases in which follow-up provided postnatal or postmortem confirmation of the prenatal findings were included in this comparison. Postnatal follow-up ranged from 3 to 8 years in the babies who were born.

Results

Of the 198 patients included, 112 (56%) were in group A, 15 (8%) in group B, 23 (12%) in group C and 48 (24%) in group D.

CT was interpreted as normal in 126 cases (64%): postnatal follow-up was only available in 41 cases, i.e. 67% of babies were lost to follow-up. Seventy-two CTs were interpreted as abnormal (34%) with postnatal or post-medical termination of pregnancy follow-up in 50 cases (70%). Thirty percent of patients were lost to follow-up.

The average gestational age when fetal CT was performed was 31.5 weeks (range 20—38). Only four CTs were performed before 26 weeks of pregnancy given a possible decision for medical termination of pregnancy.

The average CTDI dose received was 5.9 mGy.

Group A

Eighty-seven percent of CTs in this group were interpreted as normal and 71% of patients were lost to follow-up. In 14 fetuses the scan was interpreted as abnormal: follow-up was only available in 7 cases, which included 4 fetuses with Ellis Van Creveld's disease (Figs. 1 and 2), 2 fetuses with chondrodysplasia punctata (Fig. 3) and 1 fetus with metaphyseal dysplasia (Fig. 4).