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Impact of antepartum diagnostic amnioinfusion on targeted ultrasound imaging of pregnancies presenting with severe oligo- and anhydramnios: An analysis of 61 cases

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ABSTRACT

Objectives: The primary objective our study was to assess the role of diagnostic antepartum amnioinfusion on the yield from targeted ultrasounds performed in pregnancies with severe oligo- and anhydramnios.

Study design: This was a retrospective and descriptive study, conducted in the fetal medicine units of two private tertiary care referral centers in south India. The details of all the cases of diagnostic amnioinfusion performed at these two centers from January 2009 to June 2016 were collected and analyzed. Inclusion criteria were pregnancies between 17 and 26 weeks of gestational age with severe oligo- or anhydramnios. Pregnancies with obvious preterm premature rupture of membranes (PPROM) were excluded. The primary outcome measure was the improvement in diagnostic information pertaining to cause of severe oligo- and anhydramnios, and the nature of such anomalies.

Results: A total of 61 cases of were identified. The median gestational age at performance of the procedure was 22 weeks [IQR, 19.5–23]. The mean volume of normal saline infused was 314 ± 54 ml. A significant increase in the single vertical pocket (SVP) was observed following the procedure (pre-procedure SVP = 0.6 ± 0.9 cm, post procedure SVP = 3.4 ± 1.7; paired *t* test, $p < 0.001$). In 37 cases (37/61, 60.7%), there were no pre-procedure ultrasound findings. There was significant overall detection of abnormalities post procedure (mean pre-procedure findings = 0.39 ± 0.49, mean post procedure findings = 1.59 ± 1.24; paired *t* test, $p < 0.001$). The most frequent group of anomalies/abnormalities were renal (36/61, 59%), followed by PPROM (13/61, 21.3%) and finally fetal growth restriction (11/61, 18%).

Conclusion(s): Antepartum amnioinfusion is a valuable ancillary technique in prenatal diagnosis as it increases the diagnostic yield from pregnancies presenting with severe oligo- and anhydramnios.

Introduction

A pertinent biophysical utility of the amniotic fluid is its role as the physiological medium for sonographic insonation of the fetus by provision of a natural contrast [1]. In oligohydramnios which complicates 1–5% of all pregnancies, the lack of this normal acoustic window provided by the amniotic fluid restricts the sonographic assessment of the fetus [2,3]. Moreover, the prognosis of such pregnancies depends on the underlying etiology which often requires accurate diagnosis by an imaging modality [4]. Despite being unaffected by oligohydramnios, fetal MRI is an expensive procedure with additional issues of availability and expertise [5–7]. Ultrasound examination following diagnostic amnioinfusion offers a pragmatic solution to this problem.

An amnioinfusion is a prenatal procedure wherein fluid is infused into the amniotic cavity, temporarily restoring the physiological in utero aqueous environment [8]. Based on the purpose it serves, amnioinfusion is either diagnostic or therapeutic. It can be performed antepartum or intrapartum [9]. Diagnostic antepartum amnioinfusion is performed in cases of severe oligohydramnios and anhydramnios, where it enhances the detailed sonographic assessment of fetal anatomy and wellbeing, facilitating prenatal diagnosis, and providing valuable prognostic information [3,10–12]. Rarely diagnostic amnioinfusion is performed by fetal intraperitoneal instillation of fluid [13].

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Only one study has quantified the diagnostic yield from amnioinfusion previously [3]. Moreover, the ultrasound technology has undergone tremendous advances in the recent years [14]. It seems prudent to analyze the benefits of diagnostic amnioinfusion on prenatal diagnosis, in the wake of advent of modern high resolution ultrasound technology, enabled with superior color Doppler functionality. In this context, the primary objective of our study was to assess the impact of diagnostic amnioinfusion on the prenatal diagnosis of pregnancies presenting with severe oligo-anhydramnios in the second trimester.

Materials and methods

This was a retrospective, observational and comparative study, conducted in the fetal medicine units of two centers – (1) Center for infertility management and assisted reproduction (CIMAR) hospital Edappal, Malappuram, and (2) CIMAR hospital Edapally, Cochin; Kerala, India. These centers are private tertiary level referral units providing fetal medicine services to a wide range of antenatal women in north and central Kerala. As per the institutional protocol, we first counsel and offer diagnostic amnioinfusion in pregnancies presenting with severe oligo-anhydramnios in the second trimester, without any obvious history of preterm premature rupture of membranes (PPROM). This is followed by target scan performed as per ISUOG guidelines [15].

After approval from the institutional ethics board, the details pertaining to all the cases of diagnostic amnioinfusion performed at these two centers from January 2009 to June 2016 were collected and analyzed. Inclusion criteria were all pregnancies between 17^{+0} and 26 weeks of gestation presenting with severe oligohydramnios (defined as single vertical pocket less than 1 cm) or anhydramnios (no ultrasound detectable liquor pockets). Pregnancies with obvious evidence of PPROM at presentation (history of leaking, demonstrable leak of fluid per vaginum and/or positive maternal C reactive protein) were excluded. An informed written consent had been obtained from all the antenatal women, who underwent the procedure.

Ultrasound scans during this period were performed using GE Voluson PRO expert, and GE Voluson E8, using transabdominal curvilinear transducers with frequency 2–5 MHz (4CA 2-5), and 1–5 MHz (C1-5-D), respectively (GE – General Electrics, Vienna, Austria). The sequence of steps for the performance of diagnostic amnioinfusion is as follows. Pre-warmed sterile normal saline was readied, along with a three way stopcock and an intravenous fluid infusion apparatus. A single dose intravenous second generation cephalosporin was administered prior to and within an hour of performing the procedure. Sterile draping was done. Under ultrasound guidance, a 22 gauge, 8.9 cm long needle was directed into the amniotic cavity, without pre-procedure local anesthesia. To confirm successful entry of the needle tip inside the amniotic cavity, a small volume of normal saline was infused initially, and its movement as streams or jets, especially around fetal flexures was observed sonographically. Once the intramniotic entry was confirmed, further normal saline was infused using an injector syringe through the three way stopcock, till a single vertical pocket of 3–5 cm was obtained. Any leakage of fluid per vaginum was noted. After ambulating the mother for 15–30 min, a detailed ultrasound evaluation of the fetus was subsequently performed. The pre- and post-procedure ultrasound findings were documented in the case record. A diagnosis of PPROM post procedure was made if there was a demonstrable leak per vaginum with normal fetal growth and anatomy, and placental dysfunction related IUGR, if the fetal abdominal circumference and/or estimated fetal weight was less than the 10th centile with abnormal umbilical artery Doppler.

The primary objective was to assess the improvement in the diagnostic yield following ultrasound examination performed after diagnostic amnioinfusion compared to the pre-procedure ultrasound findings. The secondary objective was to describe the causes of severe oligo-anhydramnios in such pregnancies that became evident after amnioinfusion, which can form a valuable source of information for pre-procedure counseling. To materialize this objectives, the collected data was analyzed using the statistical software SPSS version 15.0 (Statistical Package for the Social Sciences, Chicago, IL, USA). Descriptive statistics was carried out with continuous variables expressed as median and inter-quartile ranges, and categorical data as percentages. Wilcoxon signed rank test was used to find the significance of study parameters on continuous scale within each group. The p values < 0.05 was taken as significant. For a difference in median number of scan findings in a pre-post design, a sample size of 61 was adequate at 5% level of significance and statistical power of 90%.

Results

During the period January 2009 to June 2016, a total of 61 diagnostic amnioinfusion were performed. The indication for the procedure was an inadequate sonographic visualization of the fetal anatomy due to anhydramnios in 41 cases (41/61, 67.2%), and severe oligohydramnios in rest of the cases (20/61, 32.8%). The median maternal age of the antenatal women was 24 years [IQR, 22–27], while the median gestational age at performance of the procedure was 22 weeks [IQR, 19.5–23]. Out of the 61 women, 34 were nullipara (34/61, 55.7%).

The mean volume of normal saline infused intra-amniotically was 314 ± 54 ml. A significant increase in the single vertical pocket (SVP) was obtained following the procedure (pre-procedure SVP = 0.6 ± 0.9 cm, post procedure SVP = 3.4 ± 1.7; paired t test, $t = -13.33$, $p < 0.001$). In 37 cases (37/61, 60.7%), there were no pre-procedure ultrasound findings, while rest of the cases had at least one finding diagnosed before the procedure (24/61, 39.3%). The performance of diagnostic amnioinfusion resulted in significant overall detection of abnormalities [median pre-procedure findings = 0.0 (0–1), median post procedure findings = 1.0 (1.0–2.0); Wilcoxon signed rank test, $z = 5.5$, $p < 0.001$). The most frequent group of anomalies/abnormalities were renal (36/61, 59%), followed by occult PPROM (13/61, 21.3%) and fetal growth restriction [12/61, 19.7%] (Table 1). A representative case highlighting the benefits of diagnostic amnioinfusion is shown in Fig. 1. Fetal karyotype was done in pregnancies with extra-renal abnormalities ($n = 17/61$, 27.9%), which were all normal. The fetal outcomes following diagnostic amnioinfusion are shown in Table 2. No procedure related losses were observed in our cases series.

Discussion

Our study showed that firstly, diagnostic amnioinfusion was a valuable adjunctive procedure in the prenatal diagnosis of pregnancies presenting with severe oligo- and anhydramnios. It provided beneficial diagnostic information in cases that otherwise would have remained inconclusive. Secondly, a wide range of conditions that potentially presents as severe oligo- and anhydramnios in the midtrimester were described. Thirdly, it was shown that despite being an invasive procedure, diagnostic amnioinfusion could be performed with relative ease, with no procedure related loss documented.

In our study, the single vertical pocket of all pregnancies ($n = 61$) improved significantly following diagnostic amnioinfusion ($p < 0.001$), allowing optimum sonographic visualization of the fetal anatomy. Previous studies have also reflected this benefit of diagnostic amnioinfusion, although without statistical means