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Review

First-trimester ultrasound determination of chorionicity in twin gestations using the lambda sign: a systematic review and meta-analysis

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ABSTRACT

Objective: To evaluate the accuracy of first-trimester sonographic determination of chorionicity in twin gestations using the lambda sign.

Study design: Electronic databases (MEDLINE, PROSPERO, Scopus, ClinicalTrials.gov, EMBASE, Sciencedirect) were searched from their inception until April 2016. We included only study assessing the accuracy lambda sign in prediction of monochorionicity in the first trimester. Forest plots for pooled sensitivity and specificity with 95% confidence intervals (CI) were generated. In addition, symmetric summary receiver-operating characteristic curves were plotted. The area under the curve (AUC) was also computed to evaluate the overall accuracy of the diagnostic test.

Results: Nine studies, including 2292 twins, were analysed. In all of these studies, identification of the lambda sign was used to diagnose chorionicity on real-time B-mode imaging. Twins were classified as monochorionic if there was a single placental mass in the absence of the lambda sign, and dichorionic if there was a single placental mass but the lambda sign was present or the placentas were not adjacent to each other. In all nine studies, placental histology or discordant fetal sex were used to confirm chorionicity. Pooled results from the meta-analysis showed that sensitivity of the presence of the lambda sign in the prediction of dichorionicity was 99% (95% CI 98–100%), and specificity was 95% (95% CI 92–97%). Pooled sensitivity of the absence of the lambda sign in the prediction of monochorionicity was 96% (95% CI 92–98%) and pooled specificity was 99% (95% CI 98–99%). The AUC for diagnostic accuracy was 0.99, and suggested very high diagnostic accuracy.

Conclusion: The lambda sign predicts chorionicity with a high degree of accuracy before 14 weeks of gestation. Presence of the lambda sign indicates dichorionicity, and absence of the lambda sign indicates monochorionicity. All hospitals should encourage departments providing ultrasound services to determine chorionicity when examining women with twin pregnancies in the first trimester. As determination of chorionicity is most accurate before 14 weeks when the amnion and chorion have not yet fused, the first-trimester scan in twin pregnancy is paramount.

Contents

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Introduction

The incidence of twin gestations in the USA has increased over the past decades [1]. Compared with dichorionic twins, monochorionic twins have inherently different complication rates, including fetal loss, fetal anomalies, intrauterine growth restriction, prematurity, twin anaemia polycythaemia sequence and twin–twin transfusion syndrome [2]. Therefore, accurate determination of chorionicity is vital when managing women with multiple gestations. The sonographic determination of chorionicity is based on the number of placental sites, the visualization of an intertwin membrane (ITM), and the identification of the so-called 'lambda' or 'twin-peak' sign on the one hand or the 'T' sign on the other [3].

The aim of this systematic review and meta-analysis was to evaluate the accuracy of first-trimester ultrasound determination of chorionicity in twin gestations using the lambda sign.

Materials and methods

This review was performed according to a protocol designed a priori and recommended for systematic review [4]. Electronic databases (MEDLINE, PROSPERO, Scopus, ClinicalTrials.gov, EMBASE, Sciencedirect, Cochrane Library, Scielo) were searched from their inception until April 2016 with no language limitations. The following search terms were used: 'twin', 'multiple', 'amnionicity', 'chorionicity', 'gestations', 'ultrasound', 'sonographic', 'pregnancy', 'transvaginal', '2D', 'lambda', 'accuracy', 'cohort', 'case–control', 'prediction', 'first trimester', 'obstetric', 'triplet' and 'sign'. No restrictions were applied for language or geographical location. In addition, the reference lists of all identified articles were examined to identify any studies that were not captured by the electronic search. The electronic search and study eligibility were assessed independently by two authors (GS, PM). Differences were discussed and consensus was reached.

This study considered randomized controlled trials, case–control studies and cohort studies. Studies were included if they reported data allowing construction of a 2×2 table. Only studies that assessed the accuracy of the lambda sign for the prediction of chorionicity in twin gestations during the first trimester were included. Studies that evaluated the accuracy of other signs (e.g. ITM, gestational sac number) for the prediction of chorionicity were excluded. Studies on triplet and high-order multifetal pregnancies were also excluded. The primary outcome of this meta-analysis was planned a priori as the accuracy of the lambda sign for the prediction of chorionicity in twin gestations.

Data abstraction and methodological quality of the included studies were completed by two independent investigators (GMM, PM). Each investigator abstracted data from each study independently. Data from each eligible study were extracted without modification of the original data to custom-made data collection forms. Disagreements were resolved by consensus with a third reviewer (GS). All authors of the original studies were contacted for missing data if possible.

The quality of each included study was assessed using Quality Assessment of Diagnostic Accuracy Studies (QUADAS) criteria [5]. Each item is scored as 'yes', 'no' or 'unclear' (if there is insufficient information to make an accurate judgement) [5]. A quality score was calculated, defined as the total number of items categorized as 'yes' among the seven items of the QUADAS criteria [5]. A study with a score $\geq$5 out of 7 was judged to have low overall low risk of bias [5].

The meta-analysis was reported in accordance with the Preferred Reporting Item for Systematic Reviews and Meta-analyses (PRISMA) statement [6]. Before data extraction, the protocol for this review was registered with the PROSPERO International Prospective Register of Systematic Reviews (Registration No. CRD42015027286) following the PRISMA guidelines for protocols (PRISMA-P) [7].

For all included studies, a 2×2 table was constructed to cross-classify the ultrasound measurement of the lambda sign and the prediction of monochorionicity. Forest plots for pooled sensitivity (i.e. detection rate) and specificity of first-trimester lambda sign for the prediction of chorionicity in twins were generated, with 95% confidence intervals (CI). Additionally, symmetric summary receiver-operating characteristic (SROC) curves were plotted. The area under the curve (AUC) and the Q^* index were also computed to evaluate the overall accuracy of the diagnostic test. The AUC of an SROC curve is a measure of the overall performance of a diagnostic test to differentiate accurately between cases with and without the condition of interest. The Q^* index is defined by the point at which sensitivity and specificity are equal, which is closest to the ideal top-left corner of the SROC space. Both values range between 0 and 1, with higher values indicating better test performance [8]. The following guidelines have been suggested for interpretation of AUC values: $0.5 \geq \text{AUC} < 0.7$, low accuracy; $0.7 \geq \text{AUC} < 0.9$, moderate accuracy; and $0.9 \geq \text{AUC} \leq 1$, high accuracy [8]. The authors planned to assess AUC for the sensitivity analysis according to the study design of the included studies.

The degree of between-study heterogeneity was evaluated using the I^2 statistic, which represents the percentage of between-study variation that is due to heterogeneity rather than chance. A value $\geq$30% indicates a substantial level of heterogeneity [4,9]. Potential publication bias was assessed statistically using Begg's and Egger's tests [9].

Data analysis was completed independently by authors (GS, PM) using Meta-DiSc 1.4 (Hospital Universitario Ramon y Cajal, Madrid, Spain). The completed analyses were compared, and any differences were resolved by review of the full data.

Results

The study flow chart is shown in Fig. 1. Thirteen studies were assessed for eligibility [10–22]. Four studies that evaluated the accuracy of ITM for the prediction of amnionicity were excluded [10–12,17]. As such, nine studies, including 2292 pair of twins, were analysed [13–16,18–22].

Begg's and Egger's tests showed no significant publication bias ($p = 0.62$ and $p = 0.71$, respectively). The statistical heterogeneity between the included studies was low ($I^2 = 0\%$). Fig. 2 shows the results of the quality assessment. None of the nine studies had a high risk of bias in patient selection and reference standard. Most studies (5/9) had a low overall risk of bias (i.e. QUADAS score $\geq$5) [13,16,18,19,21].

Table 1 shows the characteristics of the nine included studies. Of the 2292 women with twin gestations, 428 (19%) were monochorionic twins and 1864 (81%) were dichorionic twins. Four studies were from the USA [14,15,18,21]. Four studies were retrospective cohort studies [13–16] and five were prospective cohort studies [18–22]. One study was a secondary analysis of a randomized trial of preterm birth prevention in twins [18]. The method of ultrasound ascertainment was described clearly in all nine studies. Ultrasound scans were performed at <14 weeks of gestation. In seven studies, transvaginal ultrasound scans were performed using a 5-MHz transducer for B-mode imaging by a doctor with appropriate experience in early-pregnancy ultrasound assessment [14,15,18–22]. In the other two studies, ultrasound scans were performed transabdominally [13,16]. In one study, where views were suboptimal with the transabdominal ultrasound, the examination was performed transvaginally with an 8-MHz transducer [16].