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Systematic review and meta-analysis of persistent left superior vena cava on prenatal ultrasound: associated anomalies, diagnostic accuracy and postnatal outcome

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KEYWORDS: congenital heart disease; fetal echocardiography; persistent left superior vena cava; prenatal diagnosis

ABSTRACT

Objectives *To quantify the prevalence of chromosomal anomalies in fetuses with persistent left superior vena cava (PLSVC), assess the strength of the association between PLSVC and coarctation of the aorta and ascertain the diagnostic accuracy of antenatal ultrasound in correctly identifying isolated cases of PLSVC.*

Methods *MEDLINE, EMBASE, CINHAL and the Cochrane databases were searched from the year 2000 onwards using combinations of keywords 'left superior vena cava' and 'outcome'. Two authors reviewed all abstracts independently. Quality assessment of the included studies was performed using the Newcastle–Ottawa Scale for cohort studies. The rates of the following outcomes were analyzed: chromosomal abnormalities; associated intracardiac anomalies (ICAs) and extracardiac anomalies (ECAs) diagnosed prenatally; additional ICAs and ECAs detected only at postnatal imaging or clinical evaluation but missed at prenatal imaging; and association of PLSVC and coarctation of the aorta. Meta-analyses of proportions were used to combine data.*

Results *In total, 2708 articles were identified and 13 (*n = *501) were included in the systematic review. Associated ICAs and ECAs were detected at the prenatal ultrasound examination or at a follow-up assessment in 60.7% (95% CI, 44.2–75.9%) and 37.8% (95% CI, 31.0–44.8%) of cases, respectively. Chromosomal anomalies occurred in 12.5% (95% CI, 9.0–16.4%) of cases in the overall population of fetuses with PLSVC and in 7.0% (95% CI, 2.7–13.0%) of isolated cases. Additional ICAs and ECAs were detected only after birth and missed at ultrasound in 2.4% (95% CI, 0.5–5.8%) and 6.7% (95% CI, 2.2–13.2%) of cases, respectively. Coarctation of the aorta was associated with isolated PLSVC in 21.3% (95% CI, 13.6–30.3%) of cases.*

Conclusions *PLSVC is commonly associated with ICAs, ECAs and chromosomal anomalies. Fetuses with isolated PLSVC should be followed up throughout pregnancy in order to rule out coarctation of the aorta. As most of the data in this review were derived from high-risk pregnancies, the rate of associated abnormalities is likely to be higher than that in the general population of fetuses with PLSVC, for which more data are needed. Copyright © 2016 ISUOG. Published by John Wiley & Sons Ltd.*

INTRODUCTION

Persistent left superior vena cava (PLSVC) is the most common variant of anomalous systemic venous return in adults, with an estimated prevalence of 0.3–0.5% in the general population and of 4–8% in patients with congenital heart disease (CHD)[1–4]. Although the origin of PLSVC has not yet been elucidated completely, it is thought to be the result of *in-utero* failure of the left cardinal vein to develop, resulting in the presence of bilateral SVCs. Occasionally, the right SVC is absent and the venous return from the upper body enters the coronary sinus to the right atrium[5,6]. In the majority of cases, PLSVC has no clinical implications as venous blood continues to return to the right atrium, and thus hemodynamic derangement is not induced.

Postnatal series have reported a common association between PLSVC and intracardiac anomalies (ICAs),

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extracardiac anomalies (ECAs) and aneuploidy[7,8]. However, pediatric series are biased by the fact that only symptomatic patients are included, thus potentially overestimating these figures. In adults, the main significance is when a left superior venous approach to the heart is considered, such as in case of venous catheterization or pacemaker implantation[9].

The introduction of the three-vessel and the three vessels and trachea views in clinical practice for fetal heart screening has led to an increased detection rate of this anomaly[10–12]. PLSVC is diagnosed in the presence of an abnormal three-vessel view showing a supernumerary vessel to the left of the pulmonary artery and arterial duct; the diagnosis can be confirmed in the long-axis view, demonstrating direct or indirect drainage via the coronary sinus into the left or right atrium. A dilated coronary sinus is associated commonly with PLSVC and this is usually the first sign that leads to suspicion of this anomaly.

Recently, several series have reported the clinical significance of PLSVC detected at prenatal ultrasound[13]. PLSVC can be associated with a wide spectrum of CHD; however, when found in isolation, it is commonly considered a benign condition with a low likelihood for aneuploidy, associated anomalies and adverse perinatal outcome[14,15]. Despite this, the actual occurrence of chromosomal anomalies in fetuses with PLSVC is yet to be established, with most of the studies including mainly cases associated with CHD. Furthermore, in view of the relatively short period of postnatal follow-up, the diagnostic accuracy of fetal echocardiography in detecting isolated PLSVC and the rate of associated anomalies that are missed at prenatal ultrasound examination and detected only after birth have yet to be ascertained.

Finally, the association between PLSVC, even when apparently isolated, and coarctation of the aorta has been highlighted[13]. Cases with a prenatal diagnosis of PLSVC should therefore be followed up throughout pregnancy in order to rule out aortic coarctation. Despite this, the degree of association between PLSVC and aortic coarctation is still unclear, with most studies including high-risk populations with several risk factors for coarctation, such as cardiac chamber or great vessel disproportion.

The aims of this systematic review were to quantify the prevalence of chromosomal anomalies in fetuses with PLSVC, to explore the strength of the association between PLSVC and coarctation of the aorta and to ascertain the diagnostic accuracy of antenatal ultrasound in correctly identifying isolated cases of PLSVC.

METHODS

Protocol, eligibility criteria, information sources and search

This review was performed according to an *a-priori* designed protocol recommended for systematic reviews and meta-analyses[9–11,16] and following the PRISMA guidelines[17]. MEDLINE, EMBASE, CINAHL and the Cochrane databases were searched electronically on 25 October 2015, for publications from the year 2000 onwards, utilizing combinations of the relevant medical subject heading (MeSH) terms, keywords and word variants for 'left superior vena cava' and 'outcome' (Appendix S1). The search and selection criteria were restricted to the English language. Reference lists of relevant articles and reviews were hand-searched for additional reports. The study was registered with the PROSPERO database (registration number: CRD42015028116).

Study selection, data collection and data items

Two authors (S.G., M.L.) reviewed all abstracts independently. Agreement regarding potential relevance was reached by consensus; full-text articles were obtained and the same two reviewers independently extracted relevant data regarding study characteristics and pregnancy outcome. Inconsistencies were discussed by the reviewers and consensus was reached, or was reached by discussion with a third author. If more than one study was published for the same cohort with identical endpoints, the report containing the most comprehensive information on the population was included to avoid overlapping populations. For articles in which information was not reported but the methodology was such that this information would have been recorded initially, the original authors were contacted.

Quality assessment of the included studies was performed using the Newcastle–Ottawa Scale (NOS) for cohort studies; according to the NOS, each study is judged on three broad perspectives: selection of the study groups; comparability of the groups; and ascertainment of the outcome of interest[18]. Assessment of the selection of a study includes evaluation of the representativeness of the exposed cohort; selection of the non-exposed cohort; ascertainment of exposure; and demonstration that the outcome of interest was not present at the start of the study. Assessment of the comparability of the study includes the evaluation of the comparability of cohorts on the basis of the design or analysis. Finally, the ascertainment of the outcome of interest includes the evaluation of the type of the assessment of the outcome of interest, length and adequacy of follow-up[18]. According to NOS, a study can be awarded a maximum of one star for each numbered item within the selection and outcome categories. A maximum of two stars can be given for comparability[18].

Risk of bias, summary measures and synthesis of the results

The rates of the following outcomes were analyzed in fetuses with a prenatal diagnosis of PLSVC: (1) chromosomal abnormalities; (2) associated ICAs and ECAs detected at prenatal ultrasound examination; (3) additional ICAs and ECAs detected at postnatal imaging or clinical evaluation but missed at prenatal imaging; and (4) association between PLSVC and coarctation of the aorta.

All of these outcomes were assessed in the overall population of fetuses with PLSVC, in those without

associated ICAs and in isolated cases, defined as PLSVC with no ICAs or ECAs detected at the prenatal ultrasound scan.

For assessment of chromosomal anomalies, only cases that had their full karyotype tested pre- or postnatally were included. Associated ICAs and ECAs were assessed only in series reporting consecutive cases of PLSVC; studies assessing the occurrence of this condition in specific subsets of fetal anomalies, such as coarctation of the aorta, were excluded. The presence of additional anomalies detected postnatally only and the association between coarctation of the aorta and PLSVC were explored only in isolated cases.

Only studies reporting a prenatal diagnosis of PLSVC were considered suitable for inclusion in the current systematic review; postnatal studies or studies from which cases diagnosed prenatally could not be extracted were excluded. Autopsy-based studies were excluded on the basis that fetuses undergoing termination of pregnancy are more likely to show associated major structural and chromosomal anomalies. Studies published before the years 2000 were excluded, as we considered that advances in prenatal imaging techniques and improvements in the diagnosis and definition of fetal cardiac anomalies make these less relevant. Finally, studies not providing a clear classification of the anomaly were not considered suitable for inclusion in the current review.

Only full-text articles were considered eligible for inclusion; case reports, conference abstracts and case series with fewer than three cases of PLSVC, irrespective of whether the anomalies were isolated or not, were also excluded in order to avoid publication bias.

We used meta-analyses of proportions to combine data[19]. Funnel plots displaying the outcome rate from individual studies *vs* their precision (1/standard error) were carried out with an exploratory aim. Tests for funnel plot asymmetry were not used when the total number of publications included for each outcome was < 10. In this case, the power of the tests was too low to distinguish chance from real asymmetry[20–22].

Between-study heterogeneity was explored using the I^2 statistic, which represents the percentage of between-study variation that is due to heterogeneity rather than chance. A value of 0% indicates no observed heterogeneity, and I^2 values $\geq 50\%$ indicate a substantial level of heterogeneity. However, in view of the fact that all the studies considered suitable for inclusion had different designs and inclusion criteria, a random-effects model was used in all meta-analyses.

All proportion meta-analyses were carried out using StatsDirect 3.0.167 (StatsDirect Ltd, Altrincham, UK).

RESULTS

Study selection and characteristics

A total of 2708 articles were identified, of which 64 full-text articles were assessed for their eligibility for inclusion (Appendix S2). A total of 13 studies were included in the systematic review (Figure 1)[13–15,23–32]. These 13 studies included 501 fetuses with PLSVC; of these, 37.3% (95% CI, 33.1–41.7%; 187/501) were isolated. The general characteristics of the included studies are reported in Table 1.

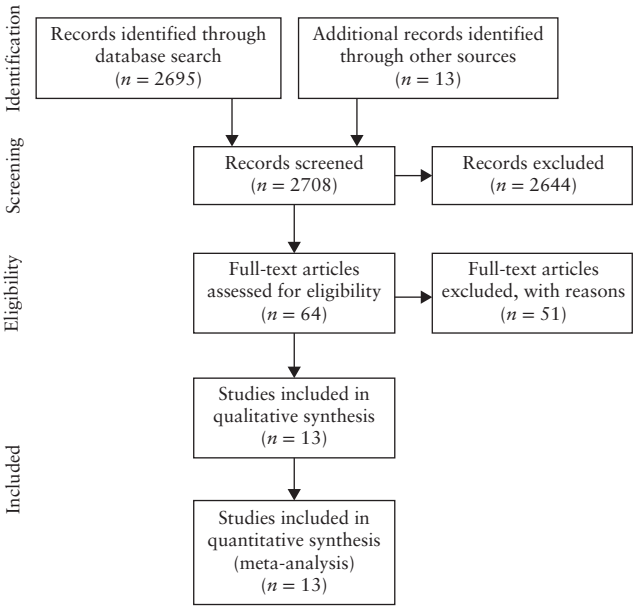

Figure 1 Flowchart summarizing selection of studies on persistent left superior vena cava diagnosed on prenatal ultrasound.

Quality assessment of the included studies was performed using the NOS for cohort studies (Table 2). Some of the included studies showed an overall good rate with regard to the selection and comparability of the study groups and for the ascertainment of the outcome of interest. The main weaknesses of these studies were their retrospective design, small sample size and inclusion of high-risk populations. Furthermore, the relatively short period of follow-up after birth did not allow for a precise estimation of the overall rate of additional anomalies missed prenatally and detected only after birth.

Synthesis of results

Associated ICAs and ECAs were detected at the initial ultrasound examination or at a follow-up assessment in 60.7% (95% CI, 44.2–75.9%; 262/449) and 37.8% (95% CI, 31.0–44.8%; 155/405) of cases, respectively (Tables 3, S1 and S2 and Figure S1).

Chromosomal anomalies occurred in 12.5% (95% CI, 9.0–16.4%; 43/353) of cases in the overall population of fetuses with PLSVC and in 11.1% (95% CI, 5.6–18.2%; 16/146) of those with no associated ICAs. When considering fetuses with isolated PLSVC, the rate of abnormal karyotype was even lower (7.0% (95% CI, 2.7–13.0%); 5/89; Table 3 and Figure 2). A summary of the chromosomal anomalies reported in fetuses with PLSVC is shown in Table S3.

Additional ICAs and ECAs were detected after birth but missed at the prenatal ultrasound in 2.4% (95% CI,

Table 1 General characteristics of 13 studies reporting on persistent left superior vena cava (PLSVC) included in systematic review

Reference	*Country*	*Study design*	*Population*	*GA (weeks)**	*Cases* (n)	*Isolated PLSVC* (n)	*Age at follow-up*
Durand (2015)[32]	France	Prosp	Fetuses with ventricular and/or vascular disproportion	NS	19	19	NS
Esmer (2014)[31]	Turkey	Retro	Fetuses referred for echo	24.5 ± 4.6	31	16	3–72 months
Du (2014)[30]	China	Retro	Pregnant women undergoing routine ultrasound examination	25 (16–35)	181	44	12 months
Jowett (2012)[29]	UK	Prosp	Fetuses with cardiac disproportion	22.4 (16.6–37.1)	8	8	NS
Barrea (2011)[28]	Belgium	Retro	Fetuses with prenatal diagnosis of abnormal cardinal systemic venous return without other CHD	26.9 (21–36.8)	19	19	NS
Rizzo (2008)[27]	Italy	Retro	Fetuses referred for echo for suspected CHD	23 (18–31)	11	4	NS
Galindo (2007)[15]	Spain	Retro	High-risk fetuses referred for echo	26 (18–38)	54	10	6 months
Berg (2006)[14]	Germany	Retro	Fetuses referred for echo	27 ± 6.8	82	13	12 months
Pasquini (2005)[13]	UK	Retro	Fetuses referred for echo	NS	16	3	NS
Head (2005)[26]	UK	Retro	Fetuses referred for echo	NS	26	20	6–8 weeks
Chaoui (2003)[25]	Germany	Prosp	Fetuses with prenatal diagnosis of CHD	NS	23	11	NS
Machevin-Surugue (2002)[24]	France	Retro	Fetuses referred for echo	27 (21–36)	22	11	NS
Rein (2000)[23]	Israel	Retro	Fetuses with large coronary sinus	25 (16–40)	9	9	NS

Only the first author of each study is given. *Data are given as mean ± SD or median (range). CHD, congenital heart disease; echo, echocardiography; GA, gestational age at diagnosis; NS, not stated; Prosp, prospective; Retro, retrospective.

Table 2 Quality assessment of the 13 included studies according to the Newcastle–Ottawa Scale

Reference	*Selection*	*Comparability*	*Outcome*
Durand (2015)[32]	★★★	★★	★★
Esmer (2014)[31]	★★	★	★★
Du (2014)[30]	★★	★	★★
Jowett (2012)[29]	★★	★	★★
Barrea (2011)[28]	★★	★	★★
Rizzo (2008)[27]	★★	★	★
Galindo (2007)[15]	★★	★★	★★★
Berg (2006)[14]	★★	★★	★★★
Pasquini (2005)[13]	★★	★	★★
Head (2005)[26]	★★	★★	★★
Chaoui (2003)[25]	★★	★	★
Machevin-Surugue (2002)[24]	★★	★	★★
Rein (2000)[23]	★★	★★	★★

Only the first author of each study is given. A study can be awarded a maximum of one star for each numbered item within the selection and outcome categories. A maximum of two stars can be given for comparability.

0.5–5.8%; 2/122) and 6.7% (95% CI, 2.2–13.2%; 4/74) of cases, respectively (Table 3 and Figure 3).

Coarctation of the aorta was associated with isolated PLSVC in 21.3% (95% CI, 13.6–30.3%; 26/129) of cases (Table 3 and Figure 4). The rate of coarctation of the aorta was 15.4% (95% CI, 8.1–24.3%; 10/72; I^2, 0%) when excluding cases that were referred to fetal echocardiography due to the presence of suspicion of aortic coarctation, such as cardiac chambers disproportion.

DISCUSSION

Main findings

This systematic review showed that PLSVC is associated with ICAs, ECAs and chromosomal anomalies in a significant proportion of cases. The likelihood of chromosomal anomalies is low in fetuses with apparently isolated PLSVC. In cases of isolated PLSVC on prenatal

Table 3 Pooled proportions (PP) for outcomes in fetuses with persistent left superior vena cava (PLSVC) diagnosed by prenatal ultrasound

Outcome	*Studies* (n)	*Fetuses* (n/N)	I^2 *(%)*	*Raw (95% CI) (%)*	*PP (95% CI) (%)*
Associated ICAs	8	262/449	90.7	58.35 (53.6–63.0)	60.66 (44.2–75.9)
Associated ECAs	7	155/405	41.5	38.27 (33.5–43.2)	37.79 (31.0–44.8)
Chromosomal anomalies					
All cases of PLSVC	8	43/353	9	12.18 (9.0–16.1)	12.45 (9.0–16.4)
PLSVC with no ICAs	8	16/146	20.8	10.96 (6.4–17.2)	11.12 (5.6–18.2)
Isolated PLSVC	8	5/89	0	5.62 (1.8–12.6)	6.95 (2.7–13.0)
Coarctation of the aorta	9	26/129	20.92	20.16 (13.6–28.1)	21.32 (13.6–30.3)
Additional ICAs detected only postnatally	8	2/122	0	1.64 (0.2–5.8)	2.42 (0.5–5.8)
Additional ECAs detected only postnatally	6	4/74	0	5.41 (1.5–13.3)	6.65 (2.2–13.2)

ECA, extracardiac anomaly; ICA, intracardiac anomaly.

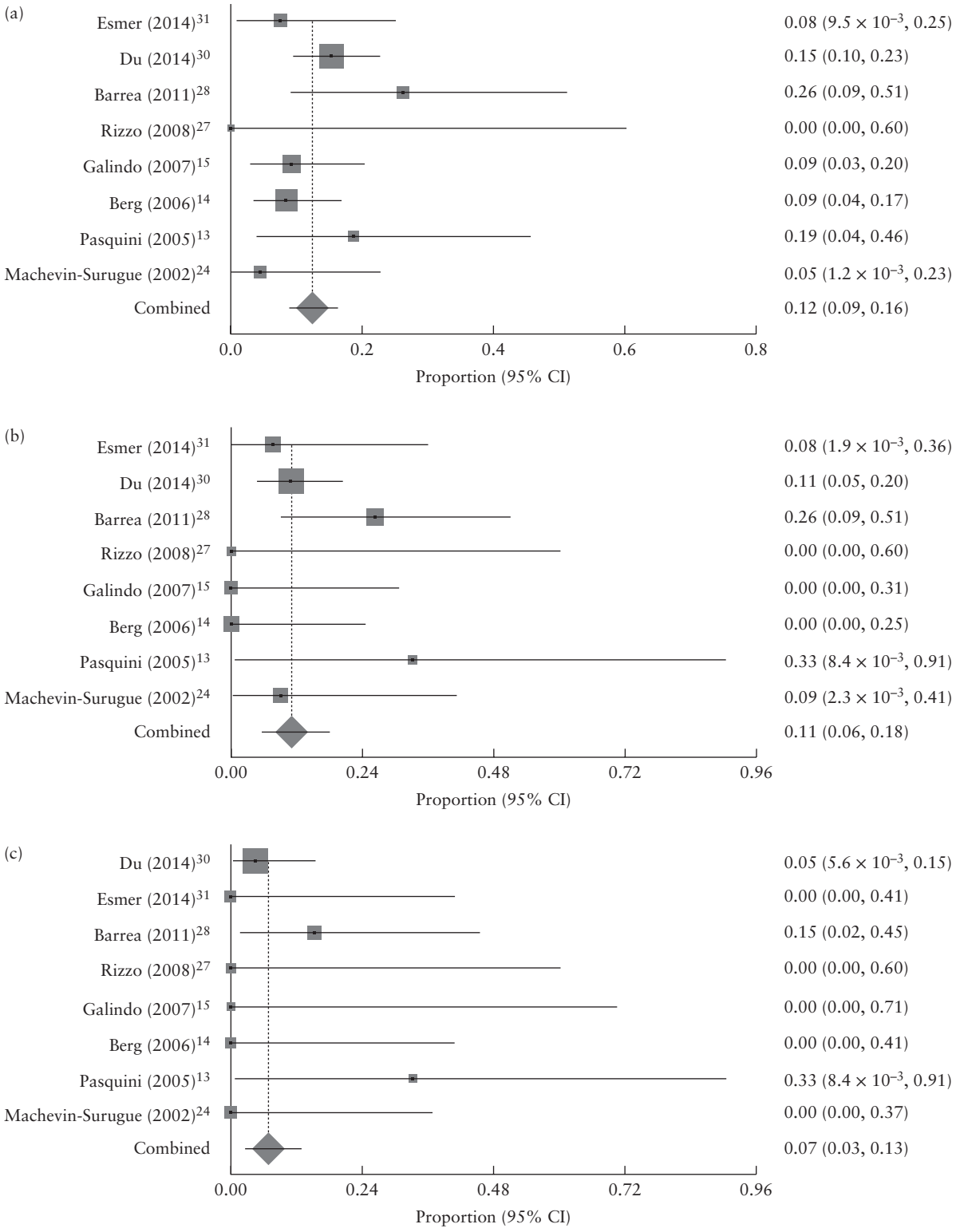

Figure 2 Pooled proportions of occurrence of chromosomal anomalies in fetuses with persistent left superior vena cava (PLSVC; a), PLSVC and no intracardiac anomalies (b) and isolated PLSVC (c). Only first author of each study is given.

ultrasound examination, additional ICAs and ECAs were detected only after birth and were missed at the initial examination in 2% and 7% of cases, respectively. Finally, coarctation of the aorta is associated with PLSVC in 21% of cases, thus requiring serial follow-up scans during pregnancy.

Strengths and limitations of the study

The major limitation of this systematic review is that most of the included studies were retrospective, involved high-risk cases and relatively small numbers, especially of those with isolated PLSVC, and had different periods of

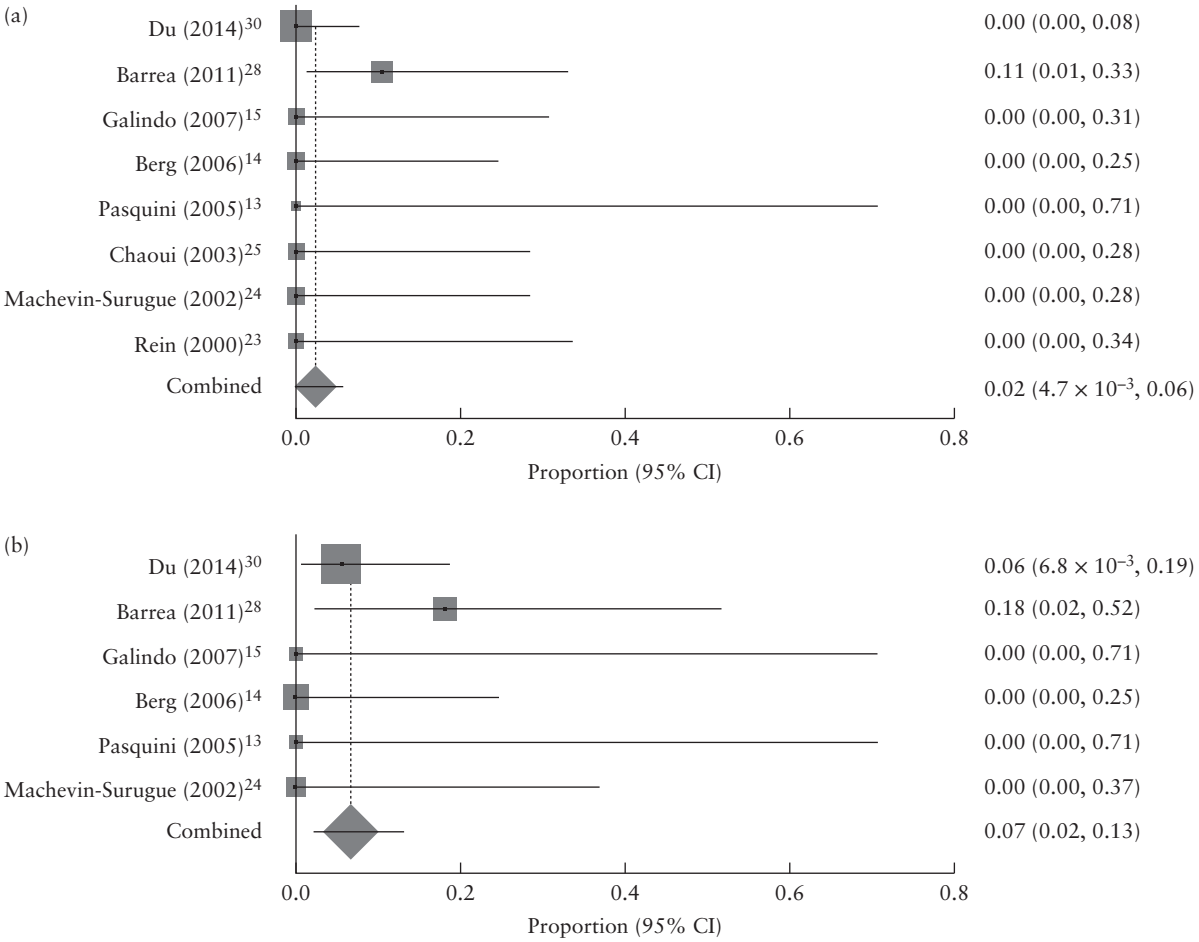

Figure 3 Pooled proportions of occurrence of additional intracardiac anomalies (a) and extracardiac anomalies (b) detected postnatally and missed on prenatal ultrasound examination in fetuses with isolated persistent left superior vena cava on initial ultrasound examination. Only first author of each study is given.

follow-up. Unfortunately, the scarce number of studies did not permit meaningful stratified meta-analyses to explore the test performance in subgroups of patients that may be less or more susceptible to bias. The assessment of the potential publication bias was also problematic, both because of the outcome nature, which limits the reliability of funnel plots, and because of the relatively low number of individual studies, which strongly limits the reliability of formal tests.

Most of the studies included in the current review involved high-risk populations because the three-vessel and three vessels and trachea views are not assessed routinely in many countries when screening for CHD; this might have led in turn to an overestimation of the associated anomalies detected at the initial scan on the basis that the detection of PLSVC might have been overlooked in fetuses not diagnosed with other anomalies. Finally, the different periods of follow-up and postnatal imaging protocols among the different studies might have biased the true occurrence of associated ICAs and ECAs detected only after birth, in view of the fact that some anomalies may manifest only later in childhood, while others can be easily overlooked at a standard clinical examination.

Despite these limitations, however, the present review represents the best published estimate of the investigated outcomes.

Implications for clinical practice

The introduction of the three-vessel and three vessels and trachea views in screening for CHD has led to an increase in the detection rate of PLSVC, especially as an isolated finding. Postnatal series and autopsy-based studies have reported an overall incidence of PLSVC of 0.3–0.5% in the general population and of 4–8% in patients with CHD[1–4]. Furthermore, a strong association between PLSVC and chromosomal or structural anomalies has been reported in pediatric series.

This systematic review shows that chromosomal anomalies are more likely to occur when PLSVC is associated with ICAs and/or ECAs. Therefore, invasive prenatal diagnosis should be considered when PLSVC is associated with ICAs and/or ECAs or when first-trimester screening tests suggest an increased risk of aneuploidy. However, even when PLSVC was isolated, the prevalence of aneuploidy was 7%. This prevalence is surprisingly higher than what was previously thought and it may

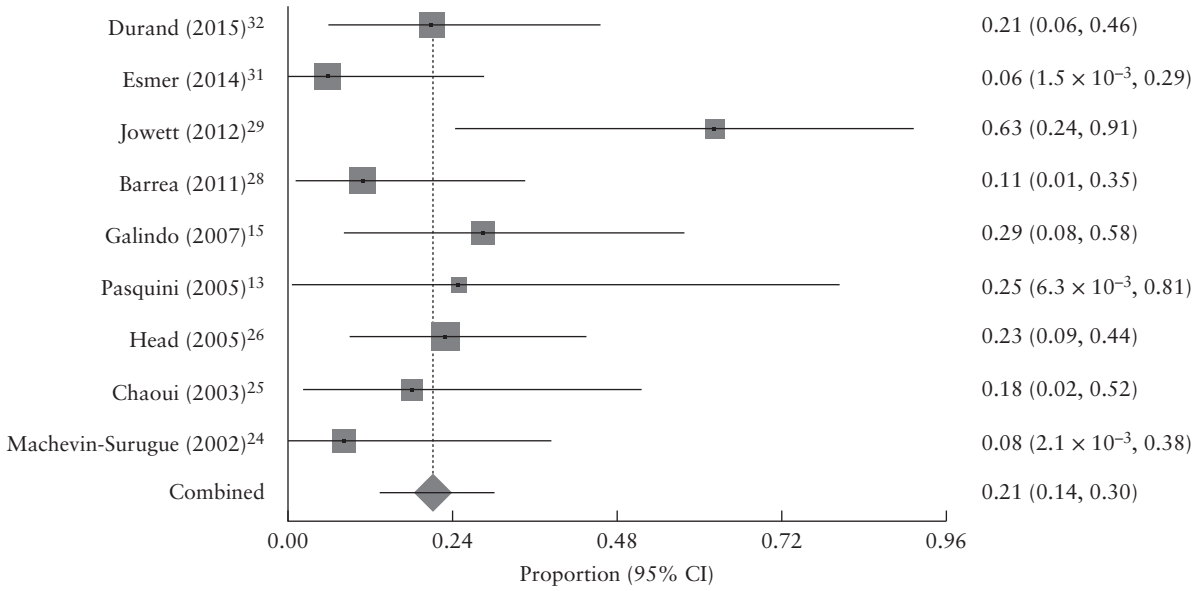

Figure 4 Pooled proportions of occurrence of coarctation of the aorta in fetuses with isolated persistent left superior vena cava. Only first author of each study is given.

be partially explained on the basis of the very small number of included cases. Karyotype analysis is not performed routinely in cases with isolated PLSVC, unless other anomalies are detected. The majority of fetuses with isolated PLSVC included in the current review did not show any phenotypic anomaly, although postnatal assessment differed significantly among the included studies. Furthermore, no information about first-trimester risk for fetal aneuploidy could be extrapolated from the included cases and it might be entirely possible that fetuses with subtle or undetected anomalies were included in the analysis. On this basis, it would be difficult to justify recommending routine prenatal invasive procedures when PLSVC with no ICAs or ECAs is detected, especially when first-trimester screening shows a low risk of aneuploidy. Future large studies are needed in order to ascertain the actual occurrence of chromosomal anomalies in fetuses with isolated PLSVC.

Chromosomal microarray (CMA) analysis allows the detection of small genomic deletions and duplications that are not routinely identified on standard cytogenetic analysis. CMA has been shown to provide useful information in patients with learning disability and congenital anomalies in whom conventional cytogenetic tests have proven negative[33]. A recent systematic review exploring the role of CMA in CHD reported an incremental yield of 7.0% in the overall population of CHD and of 3.4% in isolated cases[34]. However, when looking at the individual patient data, only cases of PLSVC with associated ICAs and/or ECAs showed additional findings at CMA analysis, thus questioning the actual contribution of this technique when PLSVC is detected as an isolated finding. In the current systematic review, we did not assess the contribution of CMA analysis because none of the included studies reported this outcome.

In this systematic review, additional ICAs and ECAs were detected only after birth and were missed at prenatal ultrasound examination in 2% and 7% of cases, respectively. Assessment of the diagnostic performance of ultrasound in detecting truly isolated cases is challenging and depends upon several factors, such as operator experience, gestational age at ultrasound examination, imaging protocol, and timing and type of postnatal follow-up. Although the findings of this review suggest that the occurrence of undetected ICAs and ECAs is relatively small, a thorough examination should be undertaken when a PLSVC is diagnosed and follow-up scans should be arranged throughout gestation in order to rule out additional anomalies.

PLSVC has been associated with an increased risk of coarctation of the aorta, even when present as an isolated finding[35–37]. Antenatal detection of aortic coarctation is generally poor in screening programs and this anomaly is usually suspected during the third trimester of pregnancy, especially when cardiac chamber or great vessel disproportion is detected[38,39]. The importance of prenatal diagnosis of this condition relies on the fact that the burden of mortality and morbidity associated with this anomaly is significantly higher when antenatal detection is missed[40]. In this systematic review, 21% of fetuses with isolated PLSVC had coarctation of the aorta. However, several studies did not look specifically at the incidence of aortic coarctation, especially when PLSVC was detected as an isolated finding. Furthermore, postnatal follow-up was not available for many cases with isolated PLSVC.

Further large studies including both low- and high-risk populations are needed in order to ascertain the actual diagnostic accuracy of different ultrasound signs and the real contribution of PLSVC to the detection of aortic coarctation. On the basis of the findings from this systematic review, we recommend that follow-up scans should be arranged, especially in the third trimester of pregnancy, in order to rule out aortic coarctation.

Conclusions

PLSVC is commonly associated with ICAs, ECAs and chromosomal anomalies. Isolated PLSVC is associated with coarctation of aorta in 21% of cases, thus suggesting the need for serial follow-up scans during pregnancy. As most data were derived from high-risk pregnancies, the rate of associated abnormalities is likely to be higher than that in the general population of fetuses with PLSVC, for which more data are needed.

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SUPPORTING INFORMATION ON THE INTERNET

Appendices S1 and **S2, Figure S1** and **Tables S1–S3** may be found in the online version of this article.

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Revisión sistemática y metaanálisis de la persistencia de la vena cava superior izquierda en la ecografía prenatal: anomalías asociadas, precisión del diagnóstico y resultado postnatal

RESUMEN

Objetivos Cuantificar la prevalencia de anomalías cromosómicas en fetos con vena cava superior izquierda persistente (VCSIP), evaluar la solidez de la asociación entre la VCSIP y la coartación aórtica, y determinar la precisión del diagnóstico de la ecografía prenatal como método para identificar correctamente casos aislados de VCSIP.

Métodos Se buscó en las bases de datos de MEDLINE, EMBASE, CINHAL y Cochrane artículos publicados desde el año 2000 en adelante, usando combinaciones de las palabras clave ''vena cava superior izquierda'' y ''resultado''. Dos de los autores revisaron de forma independiente todos los resúmenes encontrados. La evaluación de calidad de los estudios incluidos se realizó mediante la escala Newcastle-Ottawa para estudios de cohortes. Se analizaron las tasas de los siguientes resultados: anomalías cromosómicas; anomalías intracardíacas (AIC) y anomalías extracardíacas (AEC) asociadas diagnosticadas prenatalmente; AIC y AEC adicionales detectadas sólo en ecografías postnatales o mediante evaluación clínica, pero no observadas en ecografías prenatales; y la asociación entre la VCSIP y la coartación aórtica. Se utilizó un meta-análisis de proporciones para combinar los datos.

Resultados En total, se identificaron 2708 artículos y se incluyeron 13 (n = 501) en la revisión sistemática. En la ecografía prenatal o en una revisión de seguimiento se detectaron AIC y AEC asociadas en el 60,7% (IC 95%, 44,2–75,9%) y el 37,8% (IC 95%, 31,0–44,8%) de los casos, respectivamente. Se produjeron anomalías cromosómicas en el 12,5% (IC 95%, 9,0–16,4%) de los casos en la población general de fetos con VCSIP y en el 7,0% (IC 95%, 2,7–13,0%) de casos aislados. Las AIC y AEC adicionales sólo se detectaron después del nacimiento y en el 6,7% (IC 95%, 2,2–13,2%) de los casos, respectivamente. La coartación aórtica se encontró asociada con la VCSIP aislada en un 21,3% (IC 95%, 13,6–30,3%) de los casos.

Conclusiones La VCSIP está comúnmente asociada a AIC, AEC y anomalías cromosómicas. Los fetos con VCSIP aislada deben ser objeto de seguimiento durante todo el embarazo, con el fin de descartar la coartación aórtica. Como la mayoría de los datos de esta revisión proceden de embarazos de alto riesgo, es probable que la tasa de anomalías asociadas sea más alta que la de la población general de fetos con VCSIP, por lo que se necesitan más datos.

产前超声诊断永存左上腔静脉的系统综述和 meta 分析：相关畸形、诊断准确性和产后结局

目的：确定永存左上腔静脉（persistent left superior vena cava，PLSVC）胎儿染色体异常的患病率，评估 PLSVC 和主动脉缩窄的相关性，确定产前超声诊断单发性 PLSVC 的准确性。

方法：以 “左上腔静脉”和“结局”作为关键词，检索自 2000 年起 MEDLINE、EMBASE、CLNHAL 和 Cochrane 的数据库。由 2 位作者独立浏览所有摘要。采用纽卡斯尔-渥太华量表对纳入的队列研究进行质量评估。分析以下结局的发生率：染色体异常；产前诊断发现的合并的心内畸形（intracardiac anomalies，ICAs）和心外畸形（extracardiac anomalies，ECAs）；仅在出生后影像学检查或临床评估中发现但在产前影像学检查中漏诊的其他 ICAs 和 ECAs；PLSVC 和主动脉缩窄的相关性。对比例指标进行 meta 分析来合并数据。

结果：共检索到 2708 篇文献，其中 13 篇（n=501）纳入系统综述。产前超声检查以及随访评估中合并的 ICAs 和 ECAs 的发生率分别为 60.7%（95% CI，44.2%~75.9%）和 37.8%（95% CI，31.0%~44.8%）。染色体异常率在 PLSVC 胎儿总体人群以及单发性 PLSVC 的病例中分别为 12.5%（95% CI，9.0%~16.4%）和 7.0%（95% CI，2.7%~13.0%）。其他在超声检查中遗漏而仅在出生后发现的 ICAs 和 ECAs 的发生率分别为 2.4% (95% CI, 0.5–5.8%)和 6.7%（95% CI，2.2%~13.2%）。21.3%（95% CI，13.6%~30.3%）的病例中主动脉缩窄与单发性 PLSVC 相关。

结论：PLSVC 通常伴发 ICAs、ECAs 和染色体异常。应在整个妊娠期间对单发性 PLSVC 的胎儿进行随访，以排除主动脉缩窄。本篇综述中大部分数据来自高危妊娠，相关畸形发生率可能高于合并 PLSVC 胎儿的普通人群，因此需要更多的数据。