



# Systematic review of pleural-amniotic shunt insertion vs. conservative management in isolated bilateral fetal hydrothorax without hydrops

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Received: 12 March 2019 / Accepted: 4 September 2019 / Published online: 19 November 2019  
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## Abstract

**Objective** In the management of bilateral fetal hydrothorax where the fetus is non-hydropic and apparently otherwise normal, we wished to determine if pleural-amniotic shunt insertion was better than conservative management in terms of mortality.

**Methods** A systematic review was conducted between 1992 and 2017. Data extracted was inspected for heterogeneity. Where there was comparative data available, the odds ratio (OR) and confidence interval (CI) were calculated.

**Results** Seven studies were included in this systematic review. There was a paucity of comparative data where only 2 studies (28 cases) allowed for direct comparison. Within the limitations of the study, there was no difference between shunt insertion vs. conservative management in terms of stillbirth or miscarriage (OR = 1.00, 95% CI 0.12–8.34, heterogeneity  $I^2 = 0\%$ ,  $p = 1.00$ ).

**Conclusion** There is insufficient data available to determine whether the outcome is improved by pleural-amniotic shunt insertion compared with conservative management in cases of bilateral fetal hydrothorax where the fetus is non-hydropic and otherwise normal.

**Keywords** Fetal therapy · Hydrothorax · Pleural effusion · Shunt · Thoracoamniotic shunting

## Introduction

In a pregnancy complicated by a fetus with primary bilateral hydrothorax with no other identifiable anomaly, the decision for pleural-amniotic shunt insertion or conservative management can be a therapeutic dilemma. Most clinicians faced with this clinical situation would consider shunt insertion in the presence of hydrops on the grounds that conservative management would likely result in fetal demise. If, however, the fetus was not hydropic, many clinicians would adopt a conservative approach while others would offer shunt insertion.

Given that pleural-amniotic shunt insertion is not without risk, with a procedure-related loss rate of about 1%, this question merits investigation. In this paper, we propose to study pregnancy where the fetus has primary bilateral hydrothorax with no other anomaly and is not hydropic. We wished to

perform a systematic review of shunt insertion vs. conservative management in these cases.

## Materials and methods

This systematic review was based on a protocol developed using widely recommended methods for the systematic review of observational studies [10, 12, 21, 23; Henderson et al. 2009]. The study was registered with the PROSPERO database (registration number CRD42017060485; [www.crd.york.ac.uk/PROSPERO](http://www.crd.york.ac.uk/PROSPERO)).

## Search strategy

The search strategy involved searching the bibliographic databases MEDLINE and EMBASE, the Cochrane library and Web of Science between March 1992 and March 2017 inclusive, and followed the PRISMA guidelines [14]. The search terms used were “fetus, fetal, foetus, and foetal in combination with hydrothorax, chylothorax, pleural effusion, thoracoamniotic shunt, and shunting. A combination of MeSH and text words was used. All relevant abstracts were

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reviewed and where the abstract met the pre-defined selection criteria, the full article was retrieved and reviewed. No language restriction was applied. Experts in the area were consulted to ensure the review encompassed all relevant papers.

## Study selection

Selection criteria were the following:

- Population—Pregnancies with non-hydropic fetuses with primary bilateral fetal hydrothorax managed with thoracoamniotic shunting or conservative management.
- Outcome—intrauterine demise (stillbirth or miscarriage), neonatal death.
- Study design—Prospective and retrospective studies including case series involving more than 5 cases.

## Quality assessment and data extraction

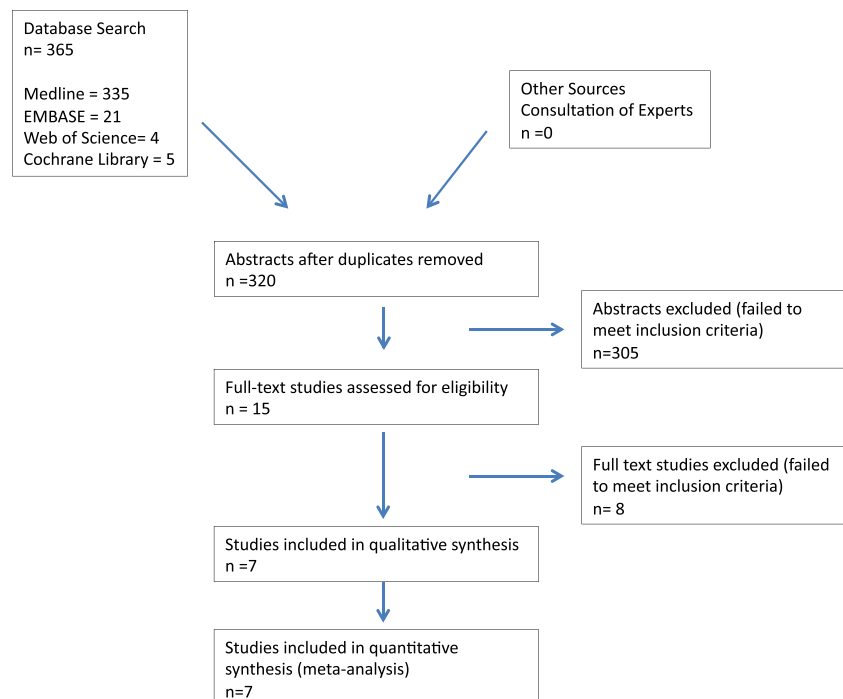
One reviewer (EC) extracted the data from all the papers meeting the selection criteria. This was checked by another reviewer (SO). The studies were assessed for quality using the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement criteria [23] and the following criteria were derived from the checklist [18]:

- Data collection—Prospective data was considered ideal; retrospective collection was considered second best.
- Description of population—A well-defined sample at a uniform early stage with clear documentation of gestation at diagnosis, gestation at intervention, and delivery was considered ideal.
- Prognostic factors considered: Clear documentation of other anomalies was considered ideal.
- Objective outcome—Clear documentation of intrauterine demise or neonatal death was considered ideal.
- Outcome ascertainment—Greater than 90% follow-up of the original study population was considered ideal, less than 90% was considered second best.

## Data synthesis

The extracted data were tabulated to allow qualitative inspection for clinical and methodological heterogeneity. The data were not weighted according to the quality of the paper. For comparison of dichotomous outcomes between groups, the odds ratio (OR) and standard errors were calculated for the association in each study. The heterogeneity of estimates was explored graphically using forest plots and formally tested using  $\chi^2$  tests. A combined proportion was calculated using the random effects models on the log odds scale. Data from individual studies were pooled [6]. The analysis of odds ratios was conducted using Review Manger 5 [1].

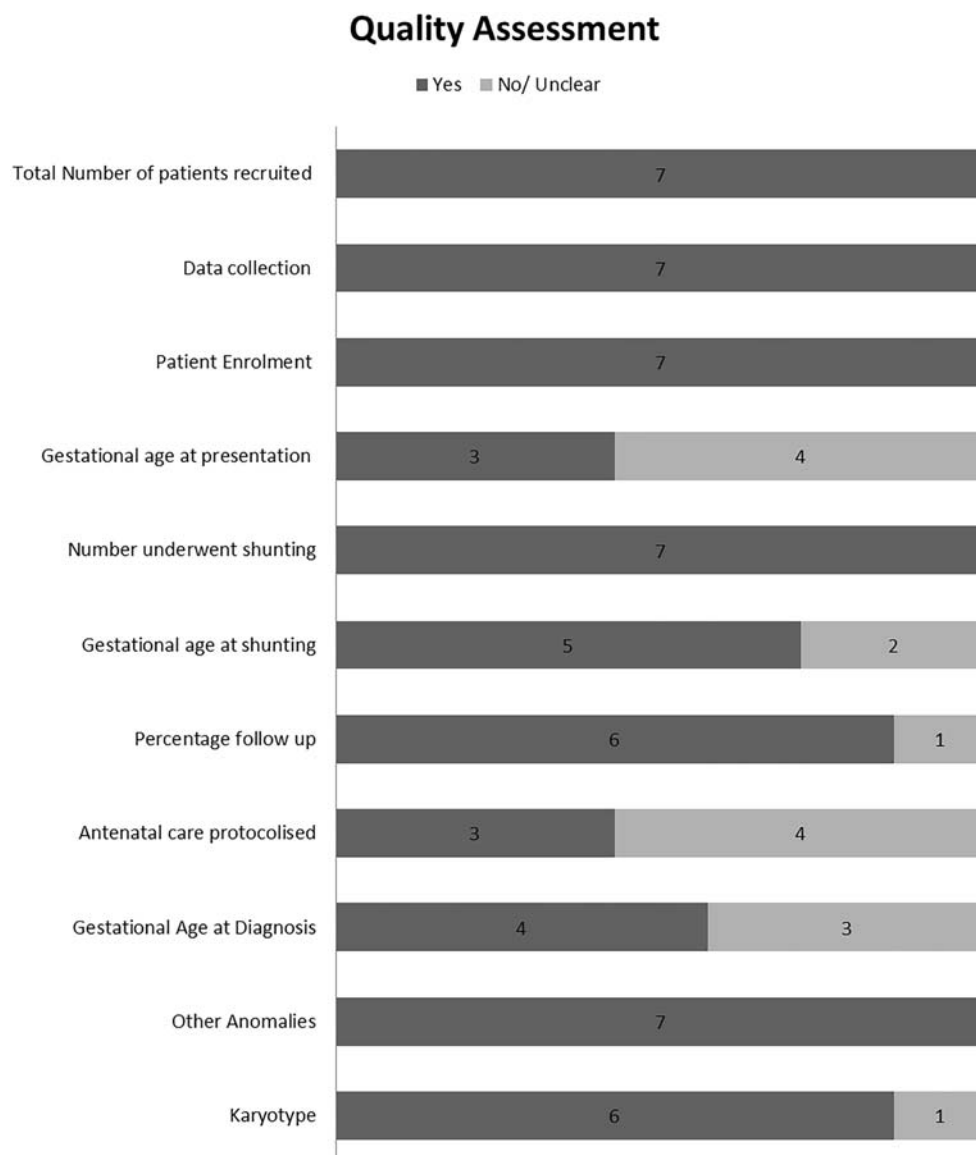
**Fig. 1** Prisma flow diagram demonstrating study selection



**Table 1** Clinical details of the 7 studies included in the systematic review

Study	Number of patients	Number of non-hydrotic fetuses with normal karyotype	Number of fetuses with shunting	Average gestation at shunting	Average gestation at delivery	Antenatal care protocolized	Outcome survival	Duration of follow-up	Complications
Bianchi [4]	28	12	28	28.5	36.2	Yes	22/28	> 5 weeks	Respiratory distress syndrome, infection, mechanical ventilation, cerebral palsy, postnatal pleurodesis
Estroff [9]	11	10	0	NA	Not reported	No	7/10	3 years	Respiratory distress syndrome, chest drain
Ba-Da Jeong [11]	68	15	65	28.3	Not reported	Yes	14/15	0.3–183 months	Pulmonary hypoplasia, preterm labor, premature rupture of membranes, hydrops, pulmonary hypertension, pulmonary hemorrhage, disseminated intravascular coagulopathy, recurrent pneumonia, restrictive lung disease, asthma
Derderian [7]	17	7	1	25	37	No	0/1	Not reported	Postnatal fluid drainage, shunt dislodgement, preterm labor
Pellegrinelli [16]	41	16	7	27	Not reported	Not reported	6/7	Not reported	Premature rupture of membranes, mirror syndrome, disseminated intravascular coagulopathy from bleeding trocar site
Takahashi	24	7	7	27.4	34.8	Yes	7/7	28 days	PPROM, catheter displacement, mirror syn, polyhydramnios
Smith	92	5	5	24	33.6	Yes	3/5	Range 8 weeks–2-years	Chest drain, removal of stuck shunt

**Fig. 2** Quality assessment of studies in the systematic review using clinically important criteria



## Results

### Identification of the literature

The electronic search of bibliographical databases yielded 335 citations, of which 15 were considered potentially relevant [3–5, 7–9, 11, 13, 15–17, 19, 20, 22, 24]. Examination of the full manuscripts revealed that 8 did not meet the selection criteria. Thus, a total of 7 primary studies [4, 7, 9, 11, 16, 20, 22] were selected for review (Fig. 1; Table 1). All studies were retrospective observational studies.

### Study characteristics and quality

The quality assessment of included studies is demonstrated in Figs. 2 and 3. The gestational age at diagnosis was reported in

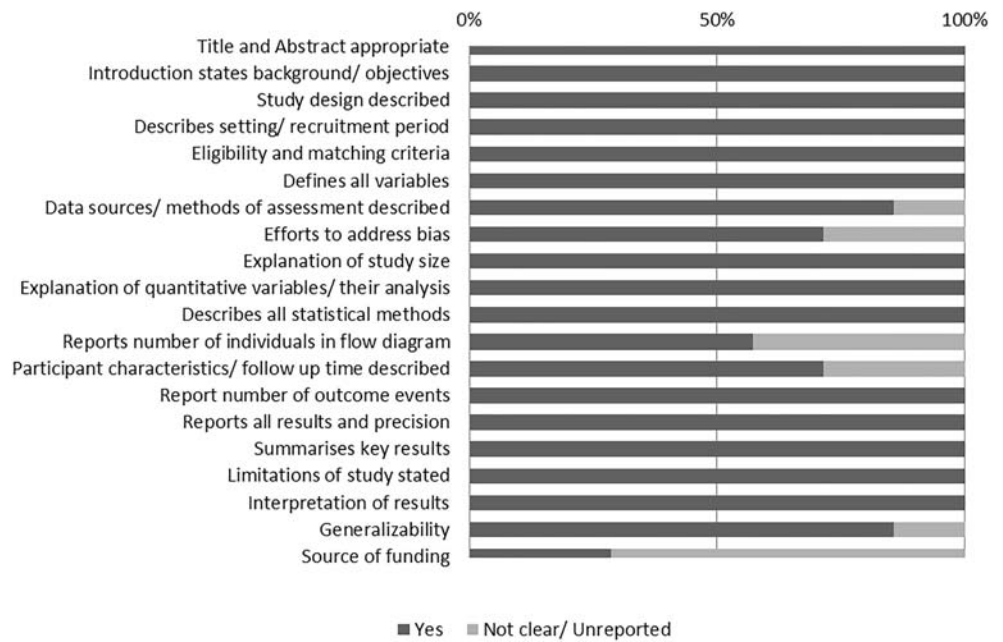
43% of studies. Gestation at shunt insertion was reported in 72% of studies.

### Survival rates following shunt insertion vs. conservative management

Only 2 of the 7 selected studies had direct comparative data of conservative management vs. pleural-amniotic shunting (Fig. 4).

There was a paucity of comparative data where only 2 studies (28 cases) allowed for direct comparison. Within the limitations of the study, there was no difference between shunt insertion vs. conservative management in terms of stillbirth or miscarriage (OR = 1.00, 95% CI 0.12–8.34, heterogeneity  $I^2 = 0%$ ,  $p = 1.00$ ).

**Fig. 3** Quality assessment of studies in the systematic review (STROBE criteria)



**Discussion**

This systematic review did not provide sufficient evidence for or against pleural-amniotic shunting in cases of bilateral hydrothorax where the fetus is non-hydropic and apparently otherwise normal. The number of cases was too small to reach a meaningful conclusion.

The strength of this review is that it employed an exhaustive research strategy. This way, we were able to collate evidence for a condition that is imprecisely assessed in individual studies. In addition, the quality of these studies was assessed.

A major weakness of this systematic review is that all the papers evaluated were retrospective in nature and the overall number of cases was very small.

A further weakness of this review is that subtle reasons whereby decision-making may change are not accounted for. For example, a clinician may see a woman with a non-hydropic fetus with bilateral hydrothorax at 20 weeks. He may decide to adopt a conservative approach as the fetus is in a difficult position for shunt insertion. By 24 weeks, the clinical picture may be the same but the fetus could be in a

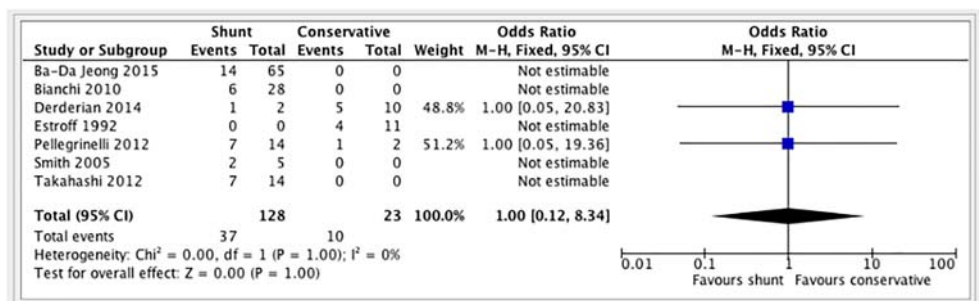
better position for shunt insertion. The clinician may well decide to opt for shunt insertion. Our systematic review would have classified such a case as an intervention. In reality, a period of conservative management followed by shunt insertion took place.

In the original conception of this systematic review, we hoped to study outcome at different gestations, i.e., 20 to 24 weeks, 24 to 28 weeks, 28 to 32 weeks, and 32 to 34 weeks. We were particularly keen to study the outcome at the later gestations, where iatrogenic premature delivery (with its attendant risk of morbidity and mortality) is a possibility. Due to the paucity of our data, we were not able to provide useful information at different gestations.

**Conclusion**

In cases of bilateral fetal hydrothorax, where the fetus is non-hydropic and otherwise structurally normal, the correct management strategy in terms of pleural-amniotic shunting or conservative management remains unknown.

**Fig. 4** Comparison of shunt insertion versus conservative management. Meta-analysis of the outcomes of stillbirth or miscarriage



A multicenter randomized controlled trial is the best way to answer this question but may prove to be an impossible undertaking. Another solution would be for several large units to standardize reporting at the outset and pool their respective results in a large observational study.

## Summary

In a pregnancy complicated by a fetus with primary hydrothorax and no other identifiable anomaly, we wished to determine whether pleural-amniotic shunt insertion was better than conservative management in terms of mortality. To do this, we conducted a systematic review between 1992 and 2017 and identified seven studies from which we could extract data. There was a paucity of comparative data with only two studies allowing for direct comparison. Within the limitations of the review, there was no difference between shunt insertion vs. conservative management.

## Compliance with ethical standards

**Conflict of interest** The authors declare that they have no conflict of interest.

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## Summary

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#### Impact statement

What is already known on this subject?

In a fetus with bilateral hydrothorax, which is hydropic, clinicians will often insert a thoracoamniotic shunt, as conservative management will often result in fetal demise. However, in the absence of hydrops, it is not clear whether shunt insertion or conservative management is preferable.

What do the results of this study add?

In fetuses with bilateral hydrothorax but no hydrops, our study indicates that there is insufficient evidence to determine if shunt insertion is better than conservative management.

What are the implications of these findings for clinical practice and/or further research?

The lack of evidence demonstrated by our systematic review highlights the need for fetal anomaly registries with standardized definitions, outcome measures, and follow-up.

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