A systematic review of motor and cognitive outcomes after early surgery for congenital heart disease
Snookes SH, Gunn JK, Eldridge BJ, Donath SM, Hunt RW, Galea MP, Shekerdemian L

CRD summary
This review concluded that there was consistent cognitive and motor development delay in children after they had undergone cardiac surgery at under six months of age. The potential for missed data, together with weaknesses and clinical heterogeneity in the included studies, mean that the authors' conclusions should be interpreted with some caution.

Authors' objectives
To examine cognitive and/or motor development after cardiac surgery during early infancy.

Searching
MEDLINE, CINAHL and EMBASE were searched from 1998 to 2008 for studies published in English. Search terms were reported. Reference lists of retrieved papers were reviewed.

Study selection
Randomised controlled trials (RCTs) and prospective cohort studies of infants who underwent surgical repair or palliation of congenital heart disease in the first six months of life were eligible for inclusion. The studies had to report motor and/or cognitive outcomes using a standardised tool. Studies were excluded if they had outcomes relating to heart transplant or isolated arterial duct ligation, were of surgery performed before 1988, or if outcomes solely of infants diagnosed with syndromes known to affect motor and/or cognitive outcomes were reported.

Most of the included studies were conducted in the USA between 1988 and 2005. Inclusion and exclusion criteria varied across studies. Included studies used the Bayley Scales of Infant Development (BSID) and the Mental Development Index (MDI) to assess cognitive outcomes during early development; the BSID and the Psychomotor Development Index (PDI) were used to assess motor outcome during early development. PDI and MDI were defined as having a mean developmental quotient of 100 and standard deviation of 15. Other measurement tools included the Wechsler Pre-school and Primary Scale of Intelligence-Revised, the Peabody Development Motor Scale, Wechsler Intelligence Scale for Children-3rd edition, and Griffiths Mental Development Scale.

Two reviewers screened studies for inclusion.

Assessment of study quality
The authors did not state they assessed quality of the included studies.

Data extraction
Two reviewers independently extracted mean cognitive and motor outcome values and standard deviations (SD). Where necessary, authors of primary studies were contacted for clarification.

Methods of synthesis
Cognitive and motor outcome values were combined in a meta-analysis to estimate the weighted mean and confidence interval (CI) if more than one study reported the same outcome. Mean outcome values and standard deviations were presented according to three age categories: early development (one year up to three years), pre-school age (three to five years), and school age (over five to 17 years). Heterogeneity was assessed by the I^2 statistic. Where necessary, subgroup analyses were performed.

Results of the review
Eight studies (number of patients not reported) met the inclusion criteria. Two studies were RCTs and six were prospective cohort studies. All the studies reported results between one and three years.
Mortality rates ranged from 0 to 25% during early development (seven studies), 2 to 22% at pre-school age (three studies), and 10% at five years of age (one study).

Cognitive and motor development generally worsened over time. For infants assessed at one year of age on the Bayley Scales, the weighted mean scores (BSID-II) were Mental Development Index 90.3 (95% CI 88.9 to 91.6; five studies; I²=55.9%), and Psychomotor Development Index 78.1 (95% CI 76.4 to 79.7; five studies; I²=69.1%). There was a moderate level of statistical heterogeneity between the studies for both analyses.

Pre-school and school age category analyses were not possible due to insufficient data.

Authors’ conclusions
The studies consistently revealed cognitive and motor development were below the expected mean in children after cardiac surgery at less than six months of age. Additional investigation is required to ascertain the consequences of such impairment during later childhood and into adult life.

CRD commentary
This review addressed a well-defined question for participants, interventions, outcomes, and study design. Relevant databases were searched, but the restriction to English language and the lack of apparent attempts to retrieve unpublished studies, means that the potential for language and publication bias could not be ruled out. Screening of the studies and data extraction was undertaken in duplicate.

The authors did not report that they assessed quality of these studies, which means the reliability of the findings was uncertain. The characteristics of the individual trials were presented. Potential sources of heterogeneity were explored. As heterogeneity was found in the studies, it may not have been appropriate to pool the data. Also, multiple publication of the same study may have been included in the meta-analysis, leading to potential double-counting. The authors acknowledged the limitations of the review.

The potential for missed data, together with weaknesses and clinical heterogeneity in the included studies, mean that the authors’ conclusions should be interpreted with some caution.

Implications of the review for practice and research
Practice: The authors did not state any implications for practice.

Research: The authors stated that future research should be performed and evaluated based on clearly defined subgroups of interest, given the current level of variation in the diagnosis of coronary heart disease, the variable timing of surgery and follow-up.

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