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Review

Is undernutrition prognostic of infection complications in children undergoing surgery? A systematic review

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SUMMARY

Background: Healthcare-associated infections are costly and are increasingly viewed as an indicator of the quality of care. Although strategies to reduce infections have become widespread, few studies have formally investigated the role of undernutrition on the development of infection-related complications in children after surgery.

Aim: To perform a systematic review of the literature to determine if undernutrition is prognostic of postoperative infection complications in children.

Methods: Electronic bibliographic and research databases were searched from 1950 to 2014. Inclusion criteria were studies in children (age <18 years) evaluating pre-operative nutritional status and reporting postoperative infection complications. Quality assessment was performed independently by two reviewers, with disagreements resolved by a third reviewer. The quality of the evidence was judged to be low in the majority of studies.

Findings: Ten cohort and two case–control studies met the inclusion criteria. Five studies reported an outcome combining infection-related complications, with the remainder reporting individual infection complications. Six studies reported surgical site infection (SSI) alone or in combination with other infection complications. Direct comparison between studies was difficult due to clinical and diagnostic heterogeneity. Unadjusted analyses (for patient or clinical variables) were suggestive of a relationship between undernutrition and infection complications. In studies controlling for other variables, the analyses did not remain significant for SSI.

Conclusion: There was low-quality evidence that undernutrition may be predictive of postoperative infection complications in children, with the exception of SSI. However, inconsistencies in nutritional and outcome assessments made it difficult to draw conclusions. Larger, high-quality studies are warranted to further investigate a potential prognostic relationship.

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Introduction

Healthcare-associated infections (HCAIs) cost the National Health Service (NHS) in excess of £700 million per year.[1] In addition, HCAI rates are increasingly being viewed as an indicator of the quality of health care.[2] Efforts to reduce the incidence of HCAIs have become widespread, and include the introduction of evidence-based clinical guidelines for reducing surgical site infection (SSI) in the UK and USA.[3,4] Few studies in children have investigated nutritional status, particularly undernutrition, as a risk factor for postoperative infection-related complications. Undernutrition can be defined as an imbalance between nutrient requirement and intake, resulting in cumulative deficits of energy, protein or micronutrients, that may have a negative effect on growth, development and other outcomes.[5] There is evidence that nutritional status deteriorates in children following hospital admission,[6,7] often when associated with chronic or critical illness.[8,9]

Poor nutritional status (measured by lower weight-for-age z-scores) has been associated with increased duration of mechanical ventilatory support, increased length of stay and increased one-year mortality in neonates undergoing surgery within an intensive care setting.[10] A recent evidence-based review of the literature found weak evidence of pre-operative nutritional assessment being predictive of adverse clinical outcomes in paediatric surgical patients.[11] However, this review only identified six studies in total, five of which were undertaken in a paediatric cardiac surgical population, limiting the validity of these findings to other surgical populations. Moreover, only two of the included studies reported infection-related outcomes.[12,13]

These observations indicate that the relationship between undernutrition and postoperative infection complications in children has not been fully delineated, justifying the need for a systematic review of the existing research literature. The subject area is important because nutritional status is a potentially modifiable risk factor. Reduction in infection-related complications after surgery can reduce the physical and psychosocial impact on both the child and his/her family, reduce the financial burden associated with medical or surgical management, and avoid prolonged hospital stay or re-admission. The costs associated with these adverse events have not been evaluated to date in paediatric surgical populations.

Methods

All studies assessing the pre-operative nutritional status of children aged <18 years undergoing surgery and reporting infection-related postoperative complications were eligible for inclusion. Studies that also included participants aged >18 years were excluded if outcome data for younger ages were not available separately. Studies were identified by searching the Cochrane Central Register of Controlled Trials (CENTRAL), OvidSP MEDLINE (1950–2014), OvidSP EMBASE (1980–2014) and NHS Evidence CINAHL (1982–2014). Index terms were exploded. A search strategy sensitive to the identification of prognostic studies was adopted.[14,15] Studies were also identified by forward and backward citation searching of all identified papers and relevant review articles. OpenGrey and ETHos were searched in an attempt to identify relevant grey literature. Only studies published in the English language were included.

The database search strategy resulted in 1067 citations with 28 duplicate titles. No further studies were identified by the CENTRAL database or grey literature searching. Following an independent review of the titles, 970 were discarded. A further 28 citations were identified by forward and backward citation searching of the remaining 69 database citations, and 14 of these were discarded following abstract screening. In total, 83 full-text articles were screened, with 30 discarded immediately following confirmation of the age of the participants. In total, 53 articles progressed to full eligibility screening. Two articles referring to the same study were identified.[16,17] Data from both papers were combined for data extraction purposes. Finally, 10 cohort studies and two case–control studies were included in this review (Figure 1).

Data extraction was performed using forms specific to this review and based on the Cochrane Collaboration template.[18] When further clarity on content was required, the primary authors were contacted. Where more than one published paper reported results from the same study participants, all papers were used to gain information relevant to this review.

The following data were extracted: study design and characteristics; country of origin; type and length of surgery; baseline participant data and eligibility criteria; nutritional assessment method with stratification of nutritional status; infection-related outcomes including definition, incidence and size of effect; duration of follow-up; assessment of confounders; and authors' conclusion.

For dichotomous infection outcomes, the appropriate relative risk or odds ratios were extracted or calculated, accompanied by 95% confidence intervals. Where more than one analysis was presented in the published article, the most adjusted analysis was extracted. Studies demonstrated significant clinical and methodological heterogeneity in terms of participants and outcome reporting; therefore, meta-analysis was not appropriate and a narrative synthesis was used to explore the relationship between classification of nutritional status and incidence of infection-related complications.

Quality assessment of included studies

The methodological quality of studies that met the inclusion criteria was assessed independently. The Newcastle-Ottawa Scale (NOS)[19] has a version for both cohort and case–control studies, and so was used to assess study quality in three domains: participant selection (representativeness), comparability (due to design or analysis) and outcomes (assessment and follow-up). All decisions regarding study quality were based upon the information presented in the published paper. Studies scoring the maximum score of 9 were considered to provide high-quality evidence, studies scoring 7 or 8 were considered to provide moderate-quality evidence, studies scoring 5 or 6 were considered to provide low-quality evidence, and studies scoring <4 were considered to provide very-low-quality evidence.

Participants needed to reflect the 'average' paediatric surgical population, and so were judged accordingly. Specialist, homogenous surgical populations were downgraded for the purposes of this review,[20] and studies recruiting from voluntary surgical databases were judged to be at unclear risk of bias.[21]

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