Review Article

Systematic review of risk factors for surgical site infection in pediatric scoliosis surgery

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Abstract

BACKGROUND CONTEXT: Risk factors for surgical site infection (SSI) in children derived from the studies in the adult population are potentially misleading because of differences in pathophysiology and management.

PURPOSE: This systematic review addresses the key question: What are the risk factors for SSI in pediatric patients undergoing scoliosis surgery?

STUDY DESIGN: This is a qualitative systematic literature review.

PATIENT SAMPLE: Retrospective and observational trials of children undergoing scoliosis surgery reported on the occurrence of risk factors for SSI and the occurrence of SSI.

METHODS: Pubmed (Medline), Ovid Evidence-Based Medicine Reviews (EBMR), Scopus, and Cumulative Index to Nursing and Allied Health (CINAHL) were searched electronically for relevant articles in all the languages between January 1, 1991 and August 27, 2012, and cross-references were checked. Two independent reviewers identified articles and appraised quality with the Agency for Healthcare Research and Quality (AHRQ) criteria based on a weighted scoring of 0 to 100.

RESULTS: Our search identified 135 abstracts and 14 studies meeting the inclusion criteria. The AHRQ grading showed that five articles were high quality with a score of greater than 67, and five articles were moderate quality with a score between 50 and 67. The percent agreement between the two independent reviewers was 84%, and kappa agreement score was 0.91 (95% confidence interval [CI]: 0.78–1.03). There were 76 risk factors identified, of which 22 factors were reported in more than one study. Odds ratios and 95% CIs were reported inconsistently. Pooled p analysis of high- and moderate-quality articles identified five risk factors predictive of SSI: inappropriate antibiotic use (p=.001), neuromuscular scoliosis (p=.014), instrumentation (p=.023), increased hospital stay days (p=.003), and residual postoperative curve (p=.003).

CONCLUSIONS: The systematic review identified inappropriate antibiotic use, neuromuscular scoliosis, instrumentation, increased hospital stay days, and residual postoperative curve as risk factors for SSI after pediatric scoliosis surgery.   © 2015 Elsevier Inc. All rights reserved.

Keywords: Risk factors; Scoliosis; Infection; Surgical site; Child; Review; Systematic; Data quality

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Introduction

Surgical site infection (SSI) is a common hospital-acquired infection, complicating approximately 300,000 to 500,000 surgeries per year in the United States and costing the health-care system upward of $1.6 billion [1]. Reported rates of SSI after scoliosis repair in children vary widely from 3% to 20% and in some studies even higher [2–13]. In this population, SSIs cause significant morbidity, often requiring readmission, reoperation, implant failure, and/or generating increased cost [14–16].

In current practice, risk prediction of SSI in children is mainly derived from the studies performed in adults. However, adult risk factors cannot be directly applied to children because of the differences in pathophysiology and health-care processes. Pediatric patients have forms of scoliosis that are rarely found in adults. A recent systematic review highlighted the lack of high-quality evidence supporting SSI prevention among pediatric spinal fusion patients [17].

The objective of this systematic review is to assess a key question: what are the risk factors for SSI in pediatric patients undergoing scoliosis surgery? Defining risk factors for SSI enables identification and assessment of potential preventive interventions and the cost-effectiveness of such implementation strategies. Surgical site infection remains a crucial topic for both anesthesiologists and surgeons; effective prevention hinges on the cooperation of all members of the operating room team [18–20].

Methods

Search strategy and selection criteria

We conducted a systematic review of research articles identifying risk factors for SSI in pediatric scoliosis surgery. We searched four databases: Pubmed (Medline), Ovid Evidence-Based Medicine Reviews (EBMR), Scopus, and the Cumulative Index to Nursing and Allied Health (CINAHL). Articles published in any language between January 1, 1991 and August 27, 2012 using "MeSH" terms, "Surgical Wound Infection," "Spine/surgery," "Risk factor," "Scoliosis," "Spine," and "Infant OR Child OR Adolescent" were searched. No limits were applied. In addition, this database search was supplemented by cross-referencing the original articles. We identified eligible articles with prespecified criteria based on the population, interventions, comparison, outcomes, and study design (PICOS). Population was children less than 18 years of age, interventions were children undergoing surgery for scoliosis, comparison was the use of standard of care for surgical intervention, outcomes was the occurrence of SSI, and study design eligible for inclusion was either randomized, prospective, or retrospective studies. Case series, case reports, systematic reviews, and meta-analyses were excluded. None of the studies were excluded based on the number of patients in the study. Studies that included any additional surgery to the scoliosis repair were not included in the review.

Data extraction

Two independent reviewers screened all the titles and abstracts. Titles or abstracts that met inclusion criteria or were inconclusive were included for full-text review. Full-text articles were reviewed based on the PICOS criteria defined earlier and selected for inclusion in the final review. A third reviewer resolved discrepancies identified after selection of the full-text articles by the independent reviewers. The two reviewers made data extraction from the reports independently on Microsoft Excel for Mac 2011 spread sheet (version 14.2.3) and scored the quality of studies using parameters defined by the Agency for Healthcare Research and Quality (AHRQ). The AHRQ parameters are based on nine criteria, each of which is further subdivided into subcategories. The nine major criteria include study question, study population, comparability of subjects for all the observational studies, intervention, outcome measures, statistical analysis, results, discussion, and funding. To maintain consistency in their selection approach, the reviewers better defined these AHRQ criteria (Appendix 1) [21–24]. A weighted score was provided for each of the subcategories for a total score of 100. A score of greater than 67 was defined as a high-quality article, 50 to 67 was considered a moderate-quality article, and less than 50 was considered a low-quality article. Bias was analyzed as a part of the AHRQ criteria at the study level.

The following data were collected for all studies: total number of cases including total number of cases and controls, mean age group of patients, duration of study period, study design, type of scoliosis studied, outcomes, and duration of follow-up. The risk factor data reported in each study were collected along with measures of effect including p values, odds ratios, and confidence intervals (CIs). Risk factors that were described in more than one high- or moderate-quality study were analyzed further. Risk factors from low-quality studies were not included in the pooled analysis.

Data synthesis and statistical analysis

The degree of agreement between the two independent reviewers in terms of study eligibility screening was measured using the percent agreement and interagreement kappa statistic [25]. The risk factors from each of the eligible studies were included if the measures of effect (odds ratios, 95% CIs, and/or p values) were provided. The summary measures of the risk ratio or difference in means were noted when available.

After identifying risk factors, a pooled quantitative analysis of measures of effect of risk factors between high- and moderate-quality articles was conducted. The p values were analyzed for those risk factors, which were identified in more