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Malnutrition and gastrointestinal complications following pediatric cardiac surgery.

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Abstract

A complication is a situation that arises because of a disease or medical procedure, deviates from the expected sequence of events, and may result in or is linked to a less-than-ideal outcome. Complications do not always signify the quality of care that qualifies as medical malpractice or negligence. Any complication, whatever of its cause, that; occurs within 30 days of a surgery or intervention, whether it occurs in or out of the hospital, or occurs after 30 days but still within the same hospitalization following the operation or intervention, is referred to as an operational or procedural complication. Operative and procedural complications in this context encompass both postoperative/post procedural complications as well as intraoperative/intra procedural complications. Spans numerous distinct databases, therapies, and various types of therapy in a common language across many separate databases. The multi-social database committee for pediatric and congenital heart disease has outlined a thorough list of complications related to the management of anesthesia and perfusion, as well as those related to the transplantation of thoracic organs, that can arise when treating patients with congenital cardiac disease. These complications include those relating to the cardiac, pulmonary, renal, hematological, infectious, neurological, gastrointestinal, and endocrine systems.

Even though serious gastrointestinal complications following congenital cardiac surgery are relatively rare, accurate estimates of their incidences are difficult to come by, in part because there is no universal nomenclature that identifies organ-specific complications and no standardized reporting practices. The objectives of this review will be identifying malnutrition and gastrointestinal complications following pediatric cardiac surgery. Electronic and manual searches of literature were performed.

A list of malnutrotion and gastrointestinal issues that might be linked to congenital heart surgery has been compiled and characterized by the multi societal database committee for pediatric and congenital heart disease. This list will be useful for databases, efforts to enhance quality, reporting of problems, and comparing treatment approaches for clinicians caring for individuals with congenital heart disease.

Keywords: Congenital heart disease, Quality improvement, Patient safety, Outcomes, Registry, Operative morbidity, Pediatric, Surgery, Congenital abnormalities, Cardiac surgical procedures, Heart, Gastrointestinal tract.

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Introduction

After cardiac surgery, severe abdominal problems are rather infrequent and have mostly been seen in adults. Adults only experience abdominal problems infrequently on average, 1.2%, with a range of 0.2% to 5.5% but when they do, the risk of morbidity and mortality is significantly elevated [1,2]. While less frequently documented in the literature, similar gastrointestinal problems are also encountered in connection with congenital heart surgery. The absence of several factors, including: 1) Uniformly applied standardized reporting; 2) Consistent reporting of outcomes beyond commonly used global performance measures, such as mortality and length of hospital stay; 3) Accurate identification of organ-specific morbidity including the temporal association with surgery; and 4) Universal nomenclature, creates limitations in estimating the incidence and burden of organ-specific complications in congenital cardiac surgery. When determining causality, there may be additional challenges, especially in unwell infants with congenital abnormalities.

When linking gastrointestinal issues to congenital heart surgery over time, there is a possibility for greater difficulty in defining standardized terminology for these difficulties. Clinical professionals and societal organizations have continued to extrapolate adult-focused diagnostic criteria for organ-specific

complications and extend these definitions to infants and young children, despite the different nature of cardiac disease in adults compared complications as well as different pre-existing morbidities and social behaviors that are frequently unique to adults. There are currently few agreed-upon criteria of certain gastrointestinal problems following congenital and pediatric heart surgery. To identify and define organ-based problems, a working group representing the multi-social database committee for pediatric and congenital heart disease was established more accurately. The purpose of this review will be identifying malnutrition and gastrointestinal complications following pediatric cardiac surgery. Electronic and manual searches of literature were performed.

Methodology

Search strategy: This systematic review will be intended to identify malnutrition and gastrointestinal complications following pediatric cardiac surgery. And make clinical relevant recommendations based upon the findings. Key words were chosen to malnutrition, gastrointestinal complications and pediatric cardiac surgery. The reporting of malnutrition and gastrointestinal complications following pediatric cardiac surgery will be required for inclusion.

A Medline PubMed search will be undertaken to identify randomized controlled trials, cohort studies and case series. A hand search of journals will be additionally undertaken to maximize the likelihood of capturing all relevant publications.

Selection of studies: Four of the authors independently will be screened the titles and abstracts obtained from the electronic search for inclusion or exclusion. Disagreements will be resolved *via* direct discussion. Full-text versions of articles will be obtained when compliance with the criteria will be required for the review is positive or when exclusion cannot be confirmed.

Five reviewers independently per will be formed a review of the full-text articles and disagreements will be again managed *via* reviewer discussion prior to final inclusion or exclusion. The search protocol is summarized in Figure 1.

Excluded studies:

Criteria for exclusion included:

- Failure to identify the inclusion criteria,
- Inability to differentiate procedures in malnutrition and gastrointestinal complications following pediatric cardiac surgery,
- Animal, histologic, or nonclinical outcomes,
- Non English language,
- Failure to report on malnutrition and gastrointestinal complications following pediatric cardiac surgery.

Included studies:

Criteria for inclusion included:

- Published last 5 years,
- Controlled clinical trials,
- Multicenter studies,
- Case report,
- Humans.

Statistical analysis: The literature will be identified in this review does not meet criteria required for quantitative data or meta-analysis. Further, the heterogeneity of the case series will be preventing the plotting of outcomes to feature results.

Literature Review

Complications are listed and defined in part 4 of this supplement under each organ system, alphabetically. The society of thoracic surgeons and the European association for cardiothoracic surgery launched the international congenital heart surgery nomenclature and database project in 1998, which served as the catalyst for the development of this list of complications [3]. The society of thoracic surgeons and the European association for cardiothoracic surgery both produced common database criteria for congenital cardiac surgery in April 2000 and included them into their own databases. Additionally, since 2000, a common complications short list has been used by the congenital heart surgery databases of the society of thoracic surgeons and the European association for cardiothoracic surgery [4].

A draught of a longer, more comprehensive complications long list was made starting with the complications short list of the society of thoracic surgeons and the European association for cardiothoracic surgery. The multi-social database committee for pediatric and congenital heart disease and its risk factors and consequences subcommittees were established as a result of this endeavor, with the goal of developing concise, precise, and widely recognized definitions of risks and consequences. The members of this interdisciplinary taskforce organized themselves into organ-specific subcommittees, each of which was tasked with developing consensus definitions for their organ-system subcommittee as well as expanding the list of complications as necessary. When available, consensus publications or current professional organizations were consulted for comprehensive definitions, and experts with knowledge of certain organs were also consulted. The multi-social database committee received the list of issues and definitions for final decision-making.

Complications involving the gastrointestinal tract's constituent organs and those fed by the celiac, superior, and inferior mesenteric arteries are referred to as gastrointestinal complications. The esophagus, stomach, small intestine, large intestine, colon, liver, gallbladder, spleen, and pancreas are some of these organs. Figure 1 presents an alphabetical list of these digestive issues. Organ-specific problems are further classified and defined according to their severity, which frequently indicates the need for treatment. For instance, the ischemic bowel certainly represents one of the more frequent gastrointestinal issues, aside from dysphagia, or the inability to eat.

The following definition of ischemic bowel is offered by the multi-social database committee for pediatric and congenital

heart disease: "Ischemic bowel is defined as a reduction in the supply of oxygenated blood to the small intestine or large intestine, typically leading to acidosis, abdominal distention, and feeding intolerance.'' Necrotizing enterocolitis reflects a similar pathophysiologic process; however, the diagnosis of necrotizing enterocolitis requires additional criteria about the diagnosis and associated treatments. Specifically, the multi-societal database committee for pediatric and congenital heart disease proposes the following consensus definition for necrotizing enterocolitis: ''Necrotizing enterocolitis is defined as an acute reduction in the supply of oxygenated blood to the small intestine or large intestine, typically resulting in acidosis, abdominal distention, pneumatosis, and/or intestinal perforation, that prompts initiation of antibiotics or exploratory laparotomy.'' Necrotizing enter colitis is further sub classified by location of involvement that is either the small bowel or the large bowel. Similar differentiation and severity grading are also included for ascites, dysphagia, gastro esophageal reflux disease, gastrointestinal bleeding, and ileus, as shown in Figure 1.

Complications with variable severity and variable need for intervention are shown in italic.

1. *Ascites*
2. *Ascites requiring drainage*
3. *Ascites requiring drainage, With paracentesis*
4. *Ascites requiring drainage, With paracentesis and placement of peritoneal drain*
5. *Ascites-modifier for type of ascites, Chylous*
6. *Ascites-modifier for type of ascites, Serous*
7. Cholecystitis
8. Colitis
9. Complication requiring laparotomy
10. *Dysphagia and/or inability to eat*
11. *Dysphagia and/or inability to eat, Resolves without the need for feeding via gastrostomy or enterostomy or hospital discharge with tube feedings*
12. *Dysphagia and/or inability to eat, Resulting in feeding via gastrostomy or enterostomy*
13. *Dysphagia and/or inability to eat, Resulting in hospital discharge with tube feedings*
14. Enteritis
15. Esophagitis
16. Gastric perforation
17. Gastritis
18. *Gastroesophageal reflux disease (GERD)*
19. *Gastroesophageal reflux disease (GERD), Medically managed*
20. *Gastroesophageal reflux disease (GERD), Surgically managed*
21. *Gastrointestinal bleeding requiring transfusion*
22. *Gastrointestinal bleeding requiring transfusion, Bright red blood per rectum*
23. *Gastrointestinal bleeding requiring transfusion, Hematemesis*
24. *Gastrointestinal bleeding requiring transfusion, Lower gastrointestinal bleeding*
25. *Gastrointestinal bleeding requiring transfusion, Melena*
26. *Gastrointestinal bleeding requiring transfusion, Upper gastrointestinal bleeding*
27. Gastrointestinal complication
28. *Ileus*
29. *Ileus, Requires bowel rest and total parenteral nutrition (TPN)*
30. *Ileus, Resolves with bowel rest without total parenteral nutrition (TPN)*
31. Intrabdominal procedural injury
32. Ischemic bowel
33. Liver dysfunction
34. Liver failure
35. *Necrotizing enterocolitis (NEC)*
36. *Necrotizing enterocolitis (NEC), With intestinal perforation*
37. *Necrotizing enterocolitis (NEC), With intestinal perforation of large intestine*
38. *Necrotizing enterocolitis (NEC), With intestinal perforation of small intestine*
39. *Necrotizing enterocolitis (NEC), Without intestinal perforation*
40. Pancreatitis
41. Typhyllitis

Figure 1. Gastrointestinal complications-final list. Precise definitions for these complications are given in part 4 of the supplement.

When compared to diagnoses like sepsis, renal failure, or respiratory failure, gastrointestinal system complications can occasionally be less clearly defined and are frequently open to interpretation as to whether certain gastrointestinal morbidities are genuine "complications" or expected results following congenital cardiac surgery. This conundrum becomes clearer when evaluating feeding issues. Gastrointestinal (GI) problems may represent functional consequences that are recognized without the use of confirmatory diagnostic methods or a clear cause-and-effect connection. In Figure 1 lists "Dysphagia and/or inability to eat" as an example of a gastrointestinal problem. For the complication of "Dysphagia and/or inability to eat," the multi-social database committee for pediatric and congenital heart disease suggests the following consensus definition. Dysphagia and/or the inability to eat are characterized as difficulties swallowing or the inability to eat, which may need the use of tube feedings, gastrostomy or enterostomy feedings, or parenteral nourishment. 'After newborn heart surgery, this diagnosis is a rather common gastrointestinal condition that is frequently made through patient observation and is open to different interpretations by the clinician.

When one tries to link the complexity to a particular event, both causally and chronologically, further disagreement results. For instance, several potentially contributing etiology, such as prolonged intubation, pre-existing abdominal pathology, intestinal ischemia, and clinician preference not to feed due to the risk of aspiration in the presence of unilateral vocal cord paresis, may contribute to an inability to eat or difficulty swallowing. Similar discrepancies might also be present with the diagnosis of gastro esophageal reflux disease, which is often subjectively diagnosed without confirmatory diagnostics, and is an expected morbidity even in the healthy infant. These discrepancies may result in variable reporting of certain gastrointestinal complications and be prohibitive in identifying the incidence of specific complications and in future validation of the specific data about these complications.

The main causes of gastrointestinal problems are tissue dysoxia or shock, ischemia, and perfusion anomalies of the splanchnic circulation. Shock-induced physiologic susceptibility is related to occurrences of ischemia and reperfusion that may take place during the preoperative and postoperative periods of time as well as the intraoperative phase, whether cardiopulmonary bypass is used. Through auto regulatory regional and global circulatory regulation, efficient oxygen supply to fulfill local metabolic demands takes place throughout the perioperative period. Specifically, the regional flow of blood is determined by the interaction of neurohumoral factors related to inflammation and the sympathetic nervous system, and local factors related to auto regulation [1,5–7].

The sympathetic response to stress that evolved to deal with hypovolemic and septic shock [8,9] is activated in all states of shock to redistribute the flow of blood to the brain and heart [10]. The organs supplied by the splanchnic circulation are the first to suffer ischemic injury because sympathetic outflow and innervation is rich in these regions [11–13] and because of the selective vasoconstriction effects of angiotensin [14,15]. The development of endotoxemia, which has been demonstrated to cause the dysfunction of numerous organs and, in some cases, death, and endogenous synthesis of inflammatory mediators are the final two main pathways associated with splanchnic ischemia [16,17].

Conclusion

A need exists for the accurate identification and measurement of complications of surgical care. The multi-social database committee for pediatric and congenital heart disease has sought to offer thorough, standardized nomenclature for problems in this population to satisfy this demand for patients with

congenital cardiac disease. Due to the linkages between the gastrointestinal and circulatory systems, the gastrointestinal system is vulnerable to complications after surgery. The non-specific nature of many gastrointestinal disorders, along with problems with accurate identification and cause attribution, pose continuous difficulties. The exhaustive list offered in this Supplement ought to be seen as a place to start for ongoing initiatives to deepen our understanding of perioperative gastrointestinal problems.

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