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Research Article

Neonatal Pneumoperitoneum & Necrotizing Enterocolitis: Aetiology and Risk Factors – Need for Early Surgical Intervention

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Abstract

Objective: Review Spectrum of causes of Neonatal Pneumoperitoneum (NP) & Necrotizing Enterocolitis (NEC), management and outcome and identify risk factors that require attention for better survival. To compare these results with published international studies in order to provide evidence-based data for formulating future treatment protocols for NEC and NP.

Methods: All neonates admitted with pneumoperitoneum at a suburban Children's Hospital in a developing low- and middle-income country (LMIC) over four years were retrospectively analyzed.

Results: n=54 / M:42 / F:12. All had pneumoperitoneum at admission. Median birth weight 2.3-kg /median age 4-days. 80% (48) referred to a nearby maternity and children's hospital. Abdominal distension was the leading symptom and sign (72%). 90% had co-morbid factors with prematurity leading factor in 28-babies (52%). Necrotizing Enterocolitis (NEC) -33 babies remained the single major cause of pneumoperitoneum in the newborn (61%). However, in 21 (39%) neonates, cause was not related to NEC – gastric perforations (6), isolated colorectal perforations (5), cecal perforations (3) and duodenal perforations (2). In other five cases no cause could be found. The predominant cause of perforation in small and large intestine was NEC. Most common site of perforation was terminal ileum. Mechanical ventilation was thought to be the cause of perforation in four of the six neonates with gastric perforations; the other two were probably related to naso-gastric tube. Intestinal Obstruction contributed to one cecal and both duodenal perforations.

Treatment individualized according to presentation. Most NEC related perforations (52%) were managed by peritoneal lavage with excision-repair of perforations. Four of the very sick preterm neonates suspect NEC were initially managed by peritoneal drains alone. All the other neonates underwent exploratory laparotomy with primary closure (n=16), resection and anastomosis (n=19), Ileostomy (n= 7), Colostomy (n=4), partial gastrectomy (n=3), and gastrojejunostomy (n=1). Eighteen neonates (33%) underwent multiple operations. Surgical site infection is the most common post-operative complication occurring in twelve neonates. Neonates who remained stable intra-operatively and those that underwent primary anastomosis had a lower mortality and decreased duration of in-patient stay than for those managed with stomas. Overall mortality was 32% (17). NEC group mortality 27% (9/33). Highest mortality 50% (3/6) seen in gastric perforations. Isolated colorectal perforations carried lowest risk of mortality 20% (1/5). Mortality rate from small bowel perforations was 27% seen mainly in neonates with NEC.

Conclusions:

a) NEC is a major cause of pneumoperitoneum in a neonate, yet there are several other causes leading to free air in the peritoneal cavity.

b) With significant advances in anesthetic, surgical, and neonatal care, most infants with NP should now be treated with laparotomy, with PD used only as a temporizing measure in small critically ill infants.

c) Multiple pediatric surgery groups presently use clinical practice guidelines that advise treating infants with NEC with laparotomy and those with NP with initial PD.

d) Surgical Drainage will invariably be required, and a prompt surgical consultation is desirable in a neonate with pneumoperitoneum.

Keywords: Neonates; necrotizing enterocolitis; neonatal pneumoperitoneum; laparotomy

Introduction

The diagnosis and management of Neonatal Pneumoperitoneum (NP) revolves around Necrotizing Enterocolitis (NEC) in most published literature [1]. Although NEC remains the major cause of pneumoperitoneum in a neonate, there are several other causes leading to free air in the peritoneal cavity. Idiopathic Pneumoperitoneum (NP) in neonates is not a rare condition reported in one series in 6% of cases with pneumoperitoneum [2]. It is a benign condition that requires conservative management [3,4]. A number of case reports have appeared describing pneumoperitoneum in a newborn due to rupture of one particular organ, but there have been only few collective reviews on the subject. The present study shares the experience with neonates admitted with a diagnosis of pneumoperitoneum in a suburban Children's Hospital in a developing low- & middle-income country (LMIC). The various causes of pneumoperitoneum in a newborn, their management and subsequent outcome are described.

Materials and Methods

The study was conducted at The Children's Hospital, Mumbai, India. Our study was carried out retrospectively to assess the outcome of early surgical intervention as the initial treatment for all newborns with NP in our locale and to compare these results with published international studies in order to provide evidence-based data for formulating future treatment protocols for NEC and NP. All neonates admitted with pneumoperitoneum over four years retrospectively analyzed. Free air was confirmed by erect abdominal X-ray or lateral decubitus films in certain cases. The data sheets were analyzed regarding age of presentation, cause of bowel perforation, management offered, and subsequent outcome achieved. All patients of NEC without evidence of perforation were not included in the study.

Results

Fifty-four neonates were admitted with diagnosis of pneumoperitoneum during period of the study. There were 42 (78%) males and only 12 (22%) females. All of them had pneumoperitoneum at the time of admission. The median birth weight was 2.3 kg and the median age at presentation was four days. Eighty nine percent (48) were referred from nearby nursing homes (maternity and children's). Abdominal distension was the leading symptom and sign (72%). Co-morbid factors were present in 90%, with prematurity as the leading factor in 28 babies (52%). NEC (33 babies) remained the single major cause of pneumoperitoneum in the newborn (61%). However, in 21 (39%) neonates, the cause was not related to NEC - gastric perforations (6), isolated colorectal perforations (5), cecal perforations (3) and duodenal perforations (2). In other five cases no cause could be found. The predominant cause of perforation in the small and large intestine was NEC and most common site of perforation was the terminal ileum. Mechanical ventilation was thought to be the cause of the perforation in four of the six neonates with gastric perforations; the other two probably related to naso-gastric tube. Intestinal Obstruction contributed to one cecal and both duodenal perforations.

Treatment was individualized according to the presentation. Most of the NEC related perforations (52%) were managed by peritoneal lavage along with excision and repair of perforations. Four of the very sick preterm neonates of suspect NEC were initially managed by peritoneal drains alone. All the other neonates underwent exploratory laparotomy with primary closure (n=16), resection and anastomosis (n=19), Ileostomy (n= 7), Colostomy (n=4), partial gastrectomy (n=3), and gastrojejunostomy (n=1). Eighteen neonates (33%) underwent multiple operations. Surgical site infection is the most common post-operative complication occurring in twelve neonates. Neonates who remained stable intra-operatively and those that underwent primary anastomosis had a lower mortality and decreased duration of in-patient stay than for those managed with stomas. Overall mortality was 32% (17). NEC group mortality was 27% (9/33). The highest mortality 50% (3/6) was seen in gastric perforations. Isolated colorectal perforations carried the lowest risk of mortality 20% (1/5). Mortality rate from small bowel perforations was 27% seen mainly in neonates with NEC.

Discussion

From [5] published the first series of five newborns treated with PD as a temporizing measure for very ill, premature infants with suspected NP. Over the next 21 years, this same Toronto group published four subsequent reports. The first two [6,7] suggested that PD may serve as definitive therapy for NP. The third one [8] reported significantly better survival with PD in infants with a weight of less than 1000 gm but better survival with laparotomy in larger infants. The last report [9], however, pointed out that because of significant advances in anesthetic, surgical, and neonatal care, most infants with NP should now be treated with laparotomy, with PD used only as a temporizing measure in small critically ill infants. Some authors [10] recommend PD as the initial treatment for all infants with NP, whereas others recommend PD as the initial treatment in newborns less than a certain weight [11,12]. Laparotomy is recommended as he preferred treatment for all infants with NEC by other authors [13-15].

Two multicentric, prospective, randomized studies comparing PD with laparotomy have been published and have reached different conclusions. The first study by Moss [16], carried out in the USA and Canada, found no difference in outcome in the entire group of 117 infants or in any of the subgroups studied. They concluded that 'the type of operation performed for perforated necrotizing enterocolitis does not influence survival lor any clinically important early outcomes in preterm infants. The second study by Rees et al. randomized 69 patients from 18 neonatal care centers in eight countries to PD or laparotomy. They concluded that 'primary intraperitoneal drainage is ineffective as either a temporizing measure or definitive treatment' for neonatal NP. [17,18] concluded, after literature reviews, that the type of surgical approach initially selected likely makes no difference in the early mortality for NP from NEC, and that major advances in outcomes of infants with NEC and NP will probably not emerge from a better operation but from improvements in medical treatment and in the prevention of NEC.

Laparotomy versus Peritoneal Drainage (PD)

Initial laparotomy would more likely benefit infants with NEC, especially those with multiple perforations and extensive intestinal necrosis and peritonitis whereas infants with NP and a single and often small perforation may require only a PD. Multiple pediatric surgery groups presently use clinical practice guidelines that advise treating infants with NEC with laparotomy and those with NP with initial PD. The only generally accepted absolute indication for operation in children with NEC is NP. Clinically, however, there is a problem in the prompt and proper diagnosis of NP. Finding free air on an abdominal radiograph is certainly the most definitive way to make the diagnosis but waiting for identification of free air can delay the recognition and treatment of NP for several hours. Abdominal paracentesis [19] has also been suggested as a method for the detection of NP. The method used in this study, in addition to serial abdominal radiographs to look for free air, was to follow the child's clinical course, including the abdominal exam (particularly progressive discoloration or increasing abdominal girth and pressure), respiratory function, and sepsis parameters.

Conclusions

a) NEC is a major cause of pneumoperitoneum in a neonate, yet there are several other causes leading to free air in the peritoneal cavity.

b) With significant advances in anesthetic, surgical, and neonatal care, most infants with NP should now be treated with laparotomy, with PD used only as a temporizing measure in small critically ill infants.

c) Multiple pediatric surgery groups presently use clinical practice guidelines that advise treating infants with NEC with laparotomy and those with NP with initial PD.

d) Surgical Drainage will invariably be required, and a prompt surgical consultation is desirable in a neonate with pneumoperitoneum.

8. Conflict of Interest

None.

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