

Pattern, outcome and risk factors contributing to Pneumoperitoneum in Neonates

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ABSTRACT

Background: Pneumoperitoneum in neonates is one of the major causes of mortality and morbidity. Neonatal pneumoperitoneum (NP) can be either surgical or non-surgical both. In case of Surgical NP, the most common cause is gastrointestinal perforation which is basically an emergency. Data about aetiology, pattern, and risk factors contributing to neonatal pneumoperitoneum and its final outcome is lacking in our setup.

Aim: To look into the pattern of pneumoperitoneum in neonates, risk factors associated with its aetiology and final outcome so that its management and preventive aspects may be improved in neonates.

Methods: An observational descriptive study was conducted in department of pediatric surgery children hospital and the institute of child health Lahore Pakistan from 1st July 2016 to 31st Dec 2017 to assess pattern, identify risk factors contributing to pneumoperitoneum and its final outcome in neonates.

Results: A total of 191 neonates with pneumoperitoneum were included in this study. 132(69%) were males. 97(50.7%) neonates presented within 5 days of age. 118(61.7%) were more 36 weeks gestational age. 117(57.6%) neonates were between 1.8 to 2.5kg. Premature rupture of membranes, hypertension, prolonged labours, diabetes mellitus, oligohydramnios and bleeding per vagina were main associated antenatal and postnatal problems in our series. 127(67%) of our neonates were on formula feeding which is one of the contributing risk factors in our series. NEC was main culprit for pneumoperitoneum in 65(47.79%) neonates followed by HD, Atresia, meconium ileus, anorectal malformations, Malrotation and perforated Meckel's diverticulum etc.

Conclusion: We conclude that pneumoperitoneum is associated with high mortality and morbidity in neonates due to prematurity, low birth weight, formula feeding and improper medical and surgical management. The early diagnosis, recognition of contributing factors, prompt management and preventive measures are needed to decrease mortality and morbidity.

Key words: Neonate, Pneumoperitoneum, Outcome, Risk factors

INTRODUCTION

Pneumoperitoneum in neonates is one of the major causes of mortality and morbidity. Neonatal pneumoperitoneum (NP) can be either surgical or non-surgical both. In case of Surgical NP, the most common cause is gastrointestinal perforation which is basically an emergency. Initially pneumoperitoneum was considered equivalent to NEC so most of the past literature described both of these together. Progressively it was found that there are also many non-NEC causes of pneumoperitoneum¹.

Neonatal surgery is one of the most important and critical area of pediatric surgery. High level of management (preoperative and post-operative) is required to get optimum results. The management of these neonates worsens the situation when there are limited resources in developing countries. Keeping in mind these issues we planned to conduct a prospective study about cases of Pneumoperitoneum in neonates regarding pattern of presentation, risk factors and final outcome after medical and surgical management of these neonates. This is the first study from our institution regarding neonates with pneumoperitoneum.

MATERIALS AND METHODS

The study was conducted in Pediatric Surgical Department of The Children Hospital and Institute of Child Health

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Lahore, Pakistan over a period of one and a half year (June 2016-Dec 2017). The study was done prospectively and all neonates admitted with diagnosis of pneumoperitoneum were included in the study. Neonates with pneumoperitoneum expired in emergency and who developed post-operative pneumoperitoneum were excluded from study. Patients admitted with a diagnosis of NEC but without evidence of pneumoperitoneum were also not included in the study (n = 56). Age and weight at the time of admission along with the delay in reaching a diagnosis was recorded. Treatment was individualized according to the general condition of the patient at the time of presentation. Primary peritoneal drainage under local anesthesia was done in most of the cases, followed by surgical exploration if warranted (indicated by increasing abdominal distension, increasing discharge from the drain or no improvement in the general condition). Complete blood count along with serum electrolytes and creatinine were performed.

Information regarding age, sex, gestational age, birth weight, clinical examination, x-rays signs value in diagnosis, causes and sites of perforations, types of operative procedures, and their effects on prognosis were recorded on a detailed proforma.

RESULTS

One hundred and thirty two (69%) were males and 59(31%) were females (Table 1). 97(50.7%) neonates were less than 5 days of age (Table 2). 118(61.7%) were >36 weeks of gestation, 62(32.5%) were 33-36 weeks and only

11(5.8%) were between 28 to 36 weeks (Table 3). Regarding weight 116(57.6%) were low birth weight ranging from 1.8-2.5kg (Table 4). Antenatal and perinatal risk factors like premature rupture of membrane, pregnancy induced hypertension, prolonged labor, twin pregnancy, oligohydramnios and Diabetes mellitus were present among 51 neonates while in 140 neonates we were unable to identify risk factors due lack of antenatal follow up/ultrasonography during pregnancy or improper documentation by referring gynecologist /lady health visitors/dais (Table 5).

136(71.2%) neonates were delivered in private Hospitals followed by 35(18.3%) at Home, 18(9%) at Government Hospitals and 2(1%) at private clinics (table6). In 161(84.3%) feeding was started before they developed pneumoperitoneum. while in 30(15.7%) neonates feed was not yet started. Out 161 milk fed neonates Formula feeding was started in 129(80.12%) neonates followed by breast feeding in 27(16.77%) neonates and cow milk feeding in 5(3.10%) neonates (Table 7). On radiologic findings 99 (51.8%) showed gas under diaphragm on plain x-ray abdomen, football sign was in 62(32.5%), Riglers sign in 18 (9.4%) and cupola sign was positive in 12 (6.3%) [Table 8].

Regarding surgical treatment 55 (28.8%) neonates underwent only peritoneal drainage under local anesthesia and could not survive for further treatment (Table 9). In 106 neonates peritoneal drainage followed by exploratory laparotomy was done while in 30(15.7%) neonates exploratory laparotomy without peritoneal drainage was done (Table 9). Out of 136 who got operated, Operative findings were gastric perforation in 27(19.85%), ileal perforation in 56(41.17%), colonic perforation in 30(22.05%), jejunal perforation in 2(1.47%)and combined perforations (intestinal plus stomach) in 5(3.67%) cases (Table 10).

The common diagnosis was NEC in 65(34%) neonates followed by anorectal malformation, Hirschsprung's disease, spontaneous perforation, meconium ileus, mackle's diverticulum, malrotation, trauma and idiopathic (Table 11). In 6 patients no perforation could be found on exploration in spite of confirmed signs of pneumoperitoneum on abdominal X-rays. Surgical procedures include stoma formation in 80(41.4%)neonates, Gastric perforation repair (14.1%), ileal perforation repair in 7(3.6%), jejunal repair in one neonate, just abdominal drain was placed In 6(3.2%) cases after laparotomy as no perforation was found, end to end anastomosis after resection of gangrenous gut in 13(6.8%),Ladd's procedure in 2(1%) and redo laparotomy was performed in 3(1.6%) neonates(Table 12).Sepsis was the major post-operative complication in 109(57%) neonates followed by wound infection in 8(4.2%), burst abdomen in 5 (2.6%),and anastomotic leak in 4(2.9%) (Table 13). 69(36.12%) neonates were discharged in satisfactory condition, 32(16.75%) expired after putting peritoneal drain before going to definitive surgery and 25(13.08%) were expired after exploratory laparotomy. 65(34.03%) patients left against medical advice before and after surgery both with overall mortality being 29.83% in our study (Table 14).

Table 1: Gender distribution

Gender	Frequency	%age
Male	132	69.1
Female	59	30.9
Total	191	100

Table 2: Age at presentation

Age at presentation (days)	Frequency	%age
1-5	97	50.7
6-10	57	29.8
11-15	18	7.3
16-20	9	4.6
20-28	10	5.1
Total	191	100

Table 3 Gestational age at presentation

Gestational age (weeks)	Frequency	%age
28-32	11	5.8
32-36	62	32.5
>36	118	61.8
Total	191	100

Table 4 Weight distribution

Weight at presentation (kg)	Frequency	%age
1.8-2.5	116	57.6
2.6-3.0	47	27.7
3.1-3.6	28	14.6
Total	191	100

Table 5 Antenatal/perinatal risk factors

Antenatal or perinatal problem	Frequency)	%age
Premature rupture of membrane>24hrs.	17	8.9
Premature rupture of membrane<24hrs.	9	4.7
Premature rupture of membrane +Hcv	1	0.5
Pregnancy induced hypertension	8	4.2
PV Bleeding	2	1.0
Oligohydramnios	1	0.5
Maternal DM + Age >40 yrs.	1	0.5
Twin pregnancy	7	3.7
Prolonged Labour	4	2.1
None	140	73.3
Total	191	100

Table 6: Place of delivery

Place of delivery	Frequency(n)	%age
Home	35	18.3
Private hospital	136	71.2
Govt. Hospital	18	9.4
Private clinic	2	1.0
Total	191	

Table 7: Feeding status

Feed given or not (pre admission)	Frequency (n)	%age
Yes	161	84.3
No	30	15.7
Total	191	100

Table 8: Radiological signs

Radiologic sign	Frequency	%age
Gas under diaphragm	99	51.8
Football sign	62	32.5
Rigler's sign	18	9.4
Cupola sign	12	6.3
Total	191	100

Table 9: Surgical management

Emergency management	Frequency	%age
Peritoneal drain Placement only	55	28.8
Emergency Laparotomy without drain placement	30	15.7
Drain placement and laparotomy	106	55.5
Total	191	100

Table 10: Operative findings of operated patients (n=136)

Operative findings	n	%age
Gastric perforations	27	19.85
Jejunal perforation	2	1.47
Ileal perforation	56	41.17
Colonic perforation	30	22.05
Combined	5	3.67
Total	136	100

Table 11: Etiology of pneumoperitoneum (operated) (n=136)

Etiology	n	%age
NEC	65	47.79
Spontaneous/idiopathic gastric /ileal perforation	19	13.9
Hirschsprung's disease	18	13.23
Anorectal malformations	8	5.88
Meconium ileus	8	5.88
Intestinal atresia	8	5.88
Malrotation with midgut volvulus	2	1.47
Meckel's diverticulum	1	0.73
Rectal perforation	1	0.37
No perforation in spite of pneumoperitoneum	6	4.41
Total	136	100

Table 12: Surgical procedures

Name of procedure	n	%age
Stoma formation	80	41.8
Gastric perforation repair	26	14.1
Ileal perforation repair	7	3.6
Jejunal perforation repair	1	0.5
Resection anastomosis	13	6.8
Ladd's procedure	2	1
Redo laparotomy	3	1.6
Abdominal drain only	6	3.2

Table 13: Postoperative complications

Complications	n	%age
Sepsis	119	87.5
Wound infection	8	5.88
Burst abdomen	5	3.67
Anastomotic leak	4	2.94
Total	136	100

Table 14: Outcome of all neonates with pneumoperitoneum

Outcome	n	%age
Discharged	69	36.12
Expired after putting drain before definite surgery	32	16.75
Expired after laparotomy	25	13.08
Left against medical advice	65	34.03
Total	191	100

Overall mortality was 29.83% in our study

DISCUSSION

Usually perforated abdominal viscera causes Neonatal Pneumoperitoneum .No doubt there is improvement in neonatal management due to better neonatal intensive care like improved ventilator management, wide range of antibiotics, availability of surfactant and total parenteral nutrition but in Pediatric Surgery gastrointestinal perforation leading to pneumoperitoneum is still a huge problem^{2,3}. The mortality in NP is still very high ranging from 12-25%⁴. Khan et al has described that NEC is the commonest cause of NP in neonates whereas 50% neonates found to have non NEC related causes of NP¹. Bowel perforation occurs in 3.2-4.4% of patients with HD, and this happens most frequently during the neonatal period⁵.

In our study about 49.3% neonates presented later than 5 days of age with the mean age of presentation (6.8days) while in other studies presentation at 4.8 days and 11.4 days has been described.^{6,7}Male neonates were affected more than female with ratio of 2.2 which is similar to other studies⁸.Majority (61%) neonates were more than 36 weeks gestational age but were of low birth weight ranging from 1.8 to 2.5 kg.129(80.12%)neonates were on formula feed already, which is actually one of major risk factor for NEC leading to pneumoperitoneum in neonates. According to one study 3 fold increase in risk of developing NEC was noted in neonates who were exclusively on formula feed as compared to Human milk⁹.

On x ray abdomen most, common diagnostic sign was gas under diaphragm (51.8%) whereas other signs noted in our study were riglers sign (9.4%) and football sign (32.5%). In case of GI perforations riglers sign found to be positive in 14-32% although there can be a pseudo-rigler sign creating confusion in which neighboring walls of distended bowel loops may give impression of free air.¹⁰In 1960s R E Miller described football sign resembling American Football which actually indicates large amount of free air in peritoneum as neonates cannot describe their symptoms and presentation is delayed so this sign is common and important which is different from adults where only 2% show this sign on plain x-ray abdomen erect^{11,12}. In our study pneumoperitoneum due to NEC was in 65(47.7%) cases and non NEC causes of intestinal perforation were found in 52.3% neonates where in other studies NEC (52.3%) and Non NEC in (49.1%) cases which include spontaneous intestinal perforation (SIP), ARM, HD, intestinal atresia, meconium ileus and gastric perforations have been described comparable to our study^{1,13}. The main reason of NEC described by Philip in 1990 was neonatal birth asphyxia leading to intestinal vascular injury¹⁴, in our series only 78(40.8%) neonates were having history of asphyxia neonatorum (ANN).

In our study SIP was in 11(5.7%) intestinal and 12(6.3%) gastric type. Considering the fact that there is no specific etiology of SIP still some authors consider it as same pathologic process with different manifestations¹⁵. Associated factors which may lead to SIP are premature rupture of membranes and low Apgar. Gastric perforation was in 13.9%. The other diseases causing pneumoperitoneum in our series were Hirschsprung's disease in 18(13.3%) cases, anorectal malformations, meconium ileus, ileal atresia, Midgut Volvulus, Meckles

diverticulum and pneumoperitoneum without any cause. Total 8(5.88%) cases were of ARM out of which one case was also associated with TEF and another one presented few days after colostomy made for ARM. In 2004 Sharma et al reported and managed 4 cases with delayed presentation whereas Chirdan et al managed five such cases^{16,17}.

Six (4.41%) neonates which were operated due to presence of clear radiologic signs of pneumoperitoneum but peroperatively no perforation was found in any part of intestine and labelled idiopathic pneumoperitoneum or pseudo-pneumoperitoneum. In another series about 10% of such cases presented with radiologic signs but no viscus perforation found similar to our series^{18,19}. Most of such cases occur in positive pressure ventilation, presence of pneumomediastinum, pneumothorax, respiratory distress syndrome and has been reported as cause of unnecessary laparotomy. No such factors were present in our cases study²⁰. Ileum was the most common site of perforation in 56(41.17%) cases, other sites include colon 30(22.05%) and stomach 27(19.85%) cases which are more or less similar to Ekwunife et al²¹. The overall mortality in our study was 30% consistent with most studies and for NEC ranges from 20–40% but approaches 100% in infants with the most severe form of the disease. Males have a higher risk of death than females. Earlier studies have reported a slight increase in the prevalence of NEC among African-American and male infants, but more recent studies have failed to verify these observations. Because NEC afflicts 2–5% of all NICU admissions and causes serious morbidity, NEC continues to impose a heavy burden on neonatal population^{22,23}.

Our study employed observational descriptive design and as such results showed comprehensive review of pattern, risk factors, morbidity and mortality in neonates diagnosed with pneumoperitoneum. But we were still aware of missing information due to lack of antenatal visits by pregnant mothers and lack of documentation even if visited to antenatal clinics, we have also major bulk of left against medical advice patients due to which we can not comment about exact morbidity and mortality in neonates with pneumoperitoneum. However, the strength of our study was a large sample size to identify a lot number of risk factors contributing to pneumoperitoneum in neonates and if we can reduce these risk factors in such neonates by producing awareness through educational seminar/workshops among health care providers especially among pediatrician and gynecologists, morbidity and mortality can be reduced due to pneumoperitoneum in neonates.

CONCLUSION

Necrotizing enterocolitis was main cause of pneumoperitoneum among neonates in 65(47.7%) cases. And formula feeding was major risk factors for pneumoperitoneum in 129(80.12%) cases followed by prematurity, low birth weight and prolonged labours. Our data emphasized that pneumoperitoneum in neonates is one of the major cause for morbidity and mortality and the risk factors contributing to its aetiology should be

controlled. However, clinician and health care provider should provide further preventive plans to reduce the diseases causing pneumoperitoneum in neonates.

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Ethical Approval and consent to participate: The data of this study was recorded on a detailed questionnaire proforma about neonates presented and operated for pneumoperitoneum in neonates after the permission of institutional review Board/ethical committee.

Competing interest: authors declare no competing interest

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