www.jpnim.com Open Access eISSN: 2281-0692
Journal of Pediatric and Neonatal Individualized Medicine 2018;7(1):e070103
doi: 10.7363/070103
Received: 2017 Apr 19; revised: 2017 Jul 01; rerevised: 2017 Jul 18; accepted: 2017 Jul 31; published online: 2017 Nov 28

Original article

One-time needle aspiration: a safe and effective treatment for neonatal spontaneous pneumoperitoneum

Kamal Nain Rattan[1], Alka Yadav[2], Poonam Dalal[2], Jasbir Singh[2], Ananta Rattan[3]

[1]Department of Pediatric Surgery, PGIMS, Rohtak, Haryana, India
[2]Department of Pediatrics, PGIMS, Rohtak, Haryana, India
[3]Department of Pediatrics, RNT Medical College, Udaipur, Rajasthan, India

Abstract

Introduction: Pneumoperitoneum is a rare surgical emergency to be seen in the neonates, occurring most commonly secondary to necrotizing enterocolitis (NEC). The term spontaneous or non-surgical pneumoperitoneum is used for cases not associated with a perforated viscus. Recommended treatment options for the former is primary peritoneal drainage (PPD) and exploratory laparotomy. Our study evaluates one-time needle aspiration alone through the right hypochondrium for effective management of the pneumoperitoneum in neonates.

Material and methods: Twenty neonates presenting to the emergency department with massive pneumoperitoneum and respiratory distress were subjected to one-time needle aspiration of the peritoneal cavity. Effectiveness of the intervention was defined by decompression of abdominal distension, permanent disappearance of free intra-peritoneal air, cessation of non-bilious aspirates and complete haemodynamic stability during the 48-hour period following the procedure.

Results: All 20 neonates improved initially with abdominal decompression by virtue of improvement in respiratory function. Of the 20 neonates, 6 neonates with spontaneous pneumoperitoneum (SIP) made a rapid recovery and needed no further surgical intervention; thereby the procedure was labeled as "effective". In the remaining 14 patients (with NEC and perforated bowel), free peritoneal air re-appeared in the next 24-48 hour period and PPD/exploratory laparotomy had to be performed. Feeds were established earlier (approximately 2 days) and mean hospital stay was significantly shorter in the group with "effective" procedure (by 3 days). Four neonates expired in postoperative period in the group requiring surgery.

Conclusion: One-time needle aspiration can serve as an effective treatment for neonates with spontaneous pneumoperitoneum and can obviate the need for exploratory laparotomy in small sick neonates with SIP who carry poor risk for extensive surgical intervention.

Keywords

Needle aspiration, neonate, necrotizing enterocolitis, pneumoperitoneum, peritoneal drainage.

Corresponding author

Dr Poonam Dalal, Associate Professor, Department of Pediatrics, PGIMS, Rohtak, Haryana, India 124001; email: drpoonam12@yahoo.com.

How to cite

Rattan KN, Yadav A, Dalal P, Singh J, Rattan A. One-time needle aspiration: a safe and effective treatment for neonatal spontaneous pneumoperitoneum. J Pediatr Neonat Individual Med. 2018;7(1):e070103. doi: 10.7363/070103.

Introduction

Pneumoperitoneum is a rare surgical emergency which can be seen in the neonatal period. Necrotizing enterocolitis (NEC) and spontaneous intestinal perforation (SIP) are the leading causes of pneumoperitoneum in neonates [1]. Pneumoperitoneum is termed spontaneous or non-surgical where no cause could be identified even after an extensive search during laparotomy and various investigations [2]. The ideal management options for neonatal pneumoperitoneum associated with NEC are the emergency laparotomy or primary peritoneal drainage (PPD); however, for SIP management options still remain a topic of debate. In continuation to our previous publication on negative laparotomies in neonates with SIP, we hereby are reporting a review of 20 cases of neonatal pneumoperitoneum managed at our tertiary care teaching institute [3, 4].

Materials and methods

It was a prospective interventional study done in the pediatric emergency department of a tertiary care referral hospital in North India. An informed written consent was taken from the parents/guardians of all the neonates before enrollment. All of the neonates who were referred from periphery with abdominal distension and pneumoperitoneum to the emergency department during the period of January 2014 to September 2015 were enrolled in the study. Pneumoperitoneum was confirmed with plain abdominal radiography and ultrasonography. Sepsis screen (C-reactive protein, complete blood counts, absolute neutrophil count and immature cell ratio) was performed for all the babies and broad spectrum antibiotics were started. All of the neonates with pneumoperitoneum were subjected to one-time needle aspiration as the first line treatment in emergency department followed by close observation in neonatal intensive care unit (NICU). The demographic data and other baseline details of the patients were recorded in details.

Procedure

Observing all universal aseptic precautions, the skin and subcutaneous area over right hypochondrium were infiltrated with 1-2% lignocaine solution. A large 16 G intravenous cannula was gently inserted perpendicularly in the peritoneal cavity through a point just below the right costal margin in mid-clavicular line. The needle was removed once the abdomen deflated after escape of air from the peritoneal cavity. Tincture iodine and pressure dressing were applied at the site of aspiration after the procedure. The neonates were kept nil per oral (NPO) with continued orogastric tube aspiration and close hemodynamic monitoring during and after the procedure for the next 48 hours in NICU. Intravenous antibiotics were given to all the patients till the reports of sepsis screen and blood culture were obtained. Enteral feeds, either intragastric or oral, were initiated after 48 hours if the baby passed stool, had a soft abdomen and had minimal or no gastric residuals. The following parameters were monitored: (1) hemodynamic stability; (2) re-appearance of abdominal distention (by serial abdominal circumference charting and radiograph); (3) gastric aspirates. Effectiveness of the intervention was defined by decompression of abdominal distension, permanent disappearance of free intra-peritoneal air, cessation of non-bilious aspirates and complete haemodynamic stability during the 48-hour period following the procedure. The patients who failed to fulfill the above criteria were taken up for PPD or exploratory laparotomy for possible bowel perforation.

Results

A total of 20 neonates who presented with pneumoperitoneum to the pediatric emergency department over the study period (January 2014 to September 2015) were enrolled in the study.

Out of 20 babies, 8 were males and 12 were females. Nine babies were born at term gestation while 11 were born preterm. Mean birth weight of the babies was 2,100 g. There was history of birth asphyxia in 5 patients needing some resuscitation steps at time of birth. History of delayed passage of meconium was present in 6 neonates. Breast feeding was established on day one of life in 9 babies, while 8 babies were fed with animal milk in the beginning. In 3 babies, feeding could not be established due to presence of symptoms since birth in form of bilious vomiting, abdominal distention or delayed/non-passage of stools. All the patients presented within the first week of their lives. The mean age of presentation was 6 days of life. The detailed demographic data is given in **Tab. 1**.

After initial stabilization, all 20 babies were subjected to one-time needle aspiration of the peritoneal cavity in the emergency department as a first line treatment. Seven out of 20 babies had pneumoperitoneum secondary to NEC, 7 babies were with intestinal perforation and 6 were diagnosed to have SIP based upon clinical features and other investigations (**Fig. 1**). In all of the neonates with NEC (7) and 4 neonates with bowel perforation, fluid was also drained along with air at peritoneal aspiration. All 20 babies responded very well to the procedure initially with decompression of abdomen immediately and improvement in respiratory distress within the next few hours. All 6 neonates with SIP showed excellent recovery and remained stable following the procedure. Post-operative radiograph revealed resolution of intra-peritoneal air (**Fig. 2**). All of them passed stools after 24-48 hours and oral/intragastric feeds were started on the third day of admission and continued successfully thereafter. They were discharged home on 9-10 day of admission and did well in follow-up. Post-operative survival was 100% in SIP group and the mean hospital stay was also significantly shorter in them.

In 14 patients pneumoperitoneum was associated with NEC and intestinal perforation. They were taken up for PPD or exploratory laparotomy once the "failure" of the initial procedure was confirmed. All of them were hemodynamically stabilized with intravenous fluids and nasogastric decompression. Mean gestational age in NEC group was 32 weeks and mean birth weight was 1,650 g. Three patients with NEC were in shock requiring inotropic support, 2 neonates with NEC were having thrombocytopenia so platelets transfusion was given, and 2 neonates were having hyponatremia which was corrected with intravenous fluids. The babies with pneumoperitoneum secondary to NEC (n = 7) were managed with PPD initially and subjected to exploratory laparotomy (n = 3) in case of non-improvement/worsening. The babies with pneumoperitoneum secondary to intestinal perforation, however, were taken up for exploratory laparotomy directly in event of

Table 1. Demographic details and clinical profile of neonates with pneumoperitoneum.

Variable	NEC (n = 7)	Perforation of intestine (n = 7)	SIP (n = 6)
Mean period of gestation (weeks)	32 ± 1.1	35 ± 1.6	34 ± 1.2
Mean birth weight (grams)	1,650	2,300	1,760
Mean age of presentation (days)	5.5	6.1	5.8
Birth asphyxia	0	2	3
Umbilical catheterization	0	0	0
Feeding not established	0	2	1
Type of feeding	Breast and animal milk	Breast milk	Breast and animal milk
Day of feed establishment (days)	7.7	5.4	3.6
Primary intervention	Needle aspiration	Needle aspiration	Needle aspiration
Second intervention	4 neonates underwent PPD	All underwent exploratory laparotomy	Not required
	3 neonates underwent PPD followed by laparotomy		
Average hospital stay (days)	13	13	10
Deaths	3	1	0

NEC: necrotizing enterocolitis; SIP: spontaneous intestinal perforation; PPD: primary peritoneal drainage.

Figure 1. Chest and abdominal radiograph of patient showing air under the diaphragm.

Figure 2. Post-intervention radiographic film showing resolution of intraperitoneal air.

non-improvement with needle decompression. On abdominal exploration, multiple bowel perforations were identifies in 7 neonates. Due to more invasive surgery, hospital stay was prolonged (by average duration of 3 days) in group where needle aspiration intervention was failed. Four neonates expired during study period with 3 in NEC group, 1 in intestinal perforation group (**Tab. 1**).

Discussion

The presence of the free air in the peritoneal cavity is termed as pneumoperitoneum. It commonly presents with signs and symptoms of peritonitis and subphrenic free air in an upright chest radiograph. NEC is the single major cause of bowel perforation accounting for one-third to half of the neonatal pneumoperitoneum. Perforated pouch colon, isolated colonic perforation, caecal perforations, gastric and duodenal perforations are the other causes of pneumoperitoneum. Reports of bowel perforation secondary to stress, hypoxia, hypo-perfusion, mechanical injuries from gavage tubes, rectal thermometers, resuscitation with oxygen under pressure, causing pneumoperitoneum are available in the literature [5]. Neonatal pneumoperitoneum sometimes is not associated with perforated viscus for which the term spontaneous or non-surgical pneumoperitoneum is used. SIP has also been observed in premature infants on mechanical ventilation, following exchange transfusion and in neonates with meconium plug syndrome [2, 6].

Traditionally neonates with NEC associated pneumoperitoneum are managed with exploratory laparotomy and surgical closure of the perforation. But at times, invasive surgical interventions cannot be performed due to hemodynamically instability. Needle aspiration can serve as a temporary stabilization procedure in these critically sick patients. There are reports of successful treatment of some patients either with diagnostic peritoneal lavage or using peritoneal drain or repeated abdominal paracentesis [7-10]. The treatment options for non-NEC associated pneumoperitoneum where no cause has been identified still remains to be explored. Reports of exploratory laparotomy on neonates with SIP revealing no significant intra-abdominal abnormality are available in the literature [3, 4, 6]. Mularski et al. found 196 reported cases of nonsurgical pneumoperitoneum of which 45 underwent surgical exploration without evidence of perforated viscus [11]. Clinical experience and intra-abdominal findings in SIP suggest a self-limiting character of the disease. Zerella and McCullough report on 5 cases of pneumoperitoneum in newborn all successfully managed with a conservative approach based on the clinical and radiological

absence of signs of bowel perforation [12]. Karaman et al. managed successfully 4 out of the 6 neonates of SIP conservatively after excluding an intra-abdominal pathology by a diagnostic peritoneal lavage and/or contrast studies [13]. Similarly, Khan et al. also reported a successful outcome in a neonate managed with the conservative approach [14]. In our study we had favorable outcome in 6 patients with SIP by using needle aspiration. The probable reason for a benign clinical course in SIP could be a subclinical small visceral perforation permitting the only leakage of air without spillage of bowel contents and get closed by itself.

Ibrahim and Ahmed reported a review of 33 patients of pneumoperitoneum including 21 neonates over a period of seven years. They concluded that repeated tapping of peritoneal cavity could serve as an alternative to surgical exploration in babies with pneumoperitoneum without peritonitis. All neonates with NEC (5/21) ultimately required exploratory laparotomy and 2 of them expired [15]. In the index study also neonates with NEC did not settle with needle aspiration and required more invasive procedure. However, one-time needle aspiration was done in our study as compared to multiple peritoneal tapping in the reported study. A recent report suggested that conservative management of pneumoperitoneum by peritoneal tapping is a viable option in neonates with NEC too, contrary to the index study [16]. It is however remarkable that the mean weight of babies with NEC in the reported study was 2,100 g as compared to 1,650 g in the index study where the neonates were small and sick preterms with an extensive intestinal disease.

We managed successfully all the patients with SIP with one-time needle aspiration only. Early clinical recovery followed by short hospital stay was observed amongst these patients. This procedure can be performed bedside and does not require modular operation theatre. General anesthesia is also not required during this procedure, so lesser complications are seen. Thus, this intervention can be of great significance for resource poor countries. The authors are of the opinion that it is important to identify spontaneous or nonsurgical etiology from the large group of patients with pneumoperitoneum, as these patients can be managed with a more conservative approach and extensive laparotomy could be avoided in them. It is difficult to differentiate between the two conditions (even if NEC is more commonly seen in preterm neonates), because history of feeding, signs of systemic sepsis (thrombocytopenia, metabolic acidosis and temperature instability) and radiological signs of pneumatosis intestinalis are usually present in most of them [17, 18]. Moreover, if at the time of needle aspiration, bilious fluid is also drained along with air, then it denotes more extensive involvement of bowel (seen in NEC and large size bowel perforation) and surgical exploration may be needed in these cases.

Conclusion

One-time needle aspiration of the peritoneal cavity is a safe and effective intervention in neonates with SIP. At the same time it can also serve as a temporary stabilization or to indicate the presence of bilious/feculent material in the peritoneum secondary to NEC or intestinal perforation before these neonates can be finally taken up for PPD or laparotomy. One-time needle aspiration can obviate the need for exploratory laparotomy in small sick neonates with SIP who carry poor risk for extensive surgical intervention.

Declaration of interest

The Authors declare that there is no conflict of interest. The Authors received no funding for this research.

References

1. Khan TR, Rawat JD, Ahmed I, Rashid KA, Maletha M, Wakhlu A. Neonatal pneumoperitoneum: a critical appraisal of its causes and subsequent management from a developing country. Pediatr Surg Int. 2009;25:1093-7.
2. Vohra K, Jenkins K, Klotz DH, French JH. Neonatal pneumoperitoneum of uncertain etiology. J Natl Med Assoc. 1992;84:633-5.
3. Aggarwal S, Rattan KN, Rattan SK, Rawal M. Medical pneumoperitoneum in a neonate: a diagnostic dilemma. J Neonatology. 2008;22:67-8.
4. Sharma A, Rattan KN, Ahalawat KS. Medical pneumoperitoneum. J Indian Med Assoc. 1995:93:212.
5. Williams NMA, Watkin DFL. Spontaneous pneumoperitoneum and other nonsurgical causes of intraperitoneal free gas. Postgrad Med J. 1997;73:531-7.
6. Van Gelder HM, Allen KB, Renz B, Sherman R. Spontaneous pneumoperitoneum. A surgical dilemma. Am Surg. 1991;57: 151-6.
7. Moss RL, Dimmitt RA, Barnhart DC, Sylvester KG, Brown RL, Powell DM, Islam S, Langer JC, Sato TT, Brandt ML, Lee H, Blakely ML, Lazar EL, Hirschl RB, Kenney BD, Hackam DJ, Zelterman D, Silverman BL. Laparotomy versus peritoneal drainage for necrotizing enterocolitis and perforation. N Engl J Med. 2006;354:2225-34.

8. Goyal A, Manalang LR, Donell SC, Llyod DA. Primary peritoneal drainage in necrotizing enerocolitis: an 18-year experience. Pediatr Surg Int. 2006; 22:449-52.
9. Upadhyaya VD, Gangopadhyay AN, Pandey A, Upadhayaya A, Mohan TV, Gopal SC. Is pneumoperitoneum an absolute indication for surgery in necrotizing enterocolitis? World J Pediatr. 2008;4:41-4.
10. Chiu B, Pillai SB, Almond PS, Beth Madonna M, Reynolds M, Luck SR, Arensman RM. To drain or not to drain: a single institution experience with neonatal intestinal perforation. J Perinat Med. 2006;34:338-41.
11. Mularski RA, Ciccolo ML, Rappaport WD. Nonsurgical causes of pneumoperitoneum. West J Med. 1999;170:41-6.
12. Zerella JT, McCullough JY. Pneumoperitoneum in infants without gastrointestinal perforation. Surgery. 1981;89:163-7.
13. Karaman A, Demirbilek S, Akin M, Gurunluoglu K, Irsi C. Does pneumoperitoneum always require laprotomy? Report of six cases and review of literature. Pediatr Surg Int. 2005;21:819-24.
14. Khan RA, Mahajan JK, Roa KN. Spontaneous intestinal perforation in neonates is surgical always indicated? Afr J Paediatr Surg. 2011;8:249-51.
15. Ibrahim IA, Ahmed EA. Tapping for pneumoperitoneum in neonates and infants. Ann Pediatr Surg. 2013;9:47-53.
16. Pandey A, Singh SP, Gupta V, Verma R. Conservative management of pneumoperitoneum in necrotizing enterocolitis – Is it possible? J Neonat Surg. 2016;5:12.
17. Harms K, Ludtke FE, Lepsien G, Speer CP. Idiopathic intestinal perforations in premature infants without evidence of necrotizing enterocolitis. Eur J Pediatr Surg. 1995;5: 30-3.
18. Williams NM, Watkin DF. Spontaneous pneumoperitoneum and other nonsurgical causes of intraperitoneal free gas. Postgrad Med J. 1997;73(863):531-7.