



ORIGINAL ARTICLE

Managing neonatal spontaneous pneumothorax: Experience in 73 neonates

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ABSTRACT

Background: Neonatal spontaneous pneumothorax causes mortality in 30-40% of cases. Neonatal pneumothorax is either primary (idiopathic) or secondary to a local lung disease. The aim of this study was to evaluate spontaneous pneumothorax in neonates and assess risk factors, causes, pathology, and treatment strategies to improve the outcome.

methods: 73 cases of neonatal pneumothorax diagnosed by clinical examination, chest radiographs, as well as biochemical analyses. Analysis of delivery method, gestational and maternal ages, birth weight, Apgar scores, sex distribution, need of resuscitation at birth, postnatal age at diagnosis, affected side, presence or absence of primary pulmonary disease or congenital malformations, length of hospital stay, and mortality were done for all participants.

Results: Secondary pneumothorax was more to be encountered than idiopathic spontaneous pneumothorax in our study, with impressively lower mortality rate (8.9%). Risk factors for neonatal spontaneous pneumothorax were elective CS in older maternal ages, prematurity, male neonates, and those with low Apgar scores. Chest tube drainage is the best tool in treating neonatal pneumothorax.

Conclusions: Meticulous monitoring of high-risk neonates pneumothorax as well as expectant treatment in these cases are essential to improve their outcome

Keywords: spontaneous pneumothorax; primary pneumothorax; Secondary pneumothorax; Neonatal pneumothorax



INTRODUCTION

Neonatal period shows the highest incidence of spontaneous pneumothorax (1-2%) compared with other life periods 0.08% of the cases encountered are symptomatic[1].

The cases in intensive care unit (N.I.C.U), Prematurity, underlying diseases, low birth weight below 1500 grams, macrosomic cases (> 5000 grams) usually due to distocia, mechanical had the major risk factors of in N.I.C.U admissions[2].

Previous reviews noted certain risk factors to be associated with cases spontaneous pneumothorax including: birth weight Iatrogenic Respiratory Distress Syndrome (R.D.S), a condition critical associated with Cesarean Section (C.S.) earlier than 38 weeks

of gestation, had accompanied by in 10.3-34.6% of affected cases [3].

Primary takes part usually due to persistently high pressure after birth resulting in alveolar rupture, whereas cases with A.R.D.S, meconium aspiration, pulmonary hypoplasia, or reanimated cases had at high risk of secondary development [4].

Mechanically ventilated cases had clearly more susceptible to develop specially those under Positive Pressure (P.P.V). All positive pressure modes play an important role in the etiology. Prolonged inspiratory time, high mean airway pressure, poor case synchronization with the ventilator, continuous positive airway pressure had other etiologic factors [5].

Clinical examination, A.B.G, altogether with chest X-ray constitute the golden trinity to diagnose cases ; Occasionally, Transillumination, ultrasonography might be helpful. If these had not available to help the diagnosis, direct needle aspiration could be a good alternative for diagnosis nevertheless, CT might be required in some cases[6].

Generally, asymptomatic cases requires no treatment. Thoracocentesis had sought for mild evacuation; while in severe cases, thoracotomy had mandatory [7], yet it had emphasized in literature as well as reviews involving autopsy examination that tube insertion in cases could cause several morbidities as: injuries, perforations, phrenic nerve paralysis, hemorrhagic pericardial effusions the reason for this had perhaps that preterm cases becoming ill with a P.T had often more critical, expectant management had too much of a risk[8].

This study aims to evaluate cases of spontaneous pneumothorax, assess risk factors, causes, pathology, treatment techniques to improve the outcome in this life-threatening slice of pediatric cases.

METHODS

All the cases enrolled in our prospective study had admitted to Neonatology Unit of our institution in the period from November 2018 to February 2020. Written informed consent had obtained from all participants` mothers, the study had approved by the research ethical committee of Faculty of Medicine, Zagazig University. The study had done according to The Code of Ethics of the World Medical Association (Declaration of Helsinki) for reviews involving humans.

In all cases, thorough clinical examination, chest radiographs, as well as biochemical analyses involved A.B.G had done. C.T., abdominal ultrasonography had used either to affirm the diagnosis in unclear cases or to detect an underlying pathology. On the other hand, chromosomal reviews had undertaken when a genetic disease had suspected.

Analyses of the method of delivery, gestational, maternal ages, birth weight, A.P.G.A.R scores (score asses pediatric condition according to

color,heart rate muscle tone, respiration, muscle irritability), sex distribution, need of resuscitation at birth, postnatal age at diagnosis, affected side, presence or absence of primary pulmonary disease or congenital malformations, length of hospital stay, mortality had done for all participants.

Treatment had subdivided to three categories according to the severity of the condition; small, asymptomatic had planned to undergo conservative management, follow up, cases with mild symptoms underwent thoracocentesis, while large or those with severe symptoms had subjected to thoracotomy.

STATISTICAL ANALYSIS

Central tendency statistical measures had used to analyze retrieved data, which had presneted as mean \pm SD.

Statistical critical had set at $p < (0.05)$.

RESULTS

73 cases of spontaneous pneumothorax admitted to the Neonatology Unit In Zagazig University Hospitals during the 16-months period of the study, Cases with possible history of trauma, macrosomic cases had been excluded.

Higher maternal ages had critical encountered in our study gathering with 55 mothers (75.5%, $p < 0.05$) above 30 years of age (35.3 ± 6.1 years), 66 mothers (91.1%, $p < 0.01$) had C.S.; of which 47 (64.4% of all cases) had elective, while 19 (26.6% of all cases) had emergency C.S., 53 of C.S. (73.3% of the whole study, $p < 0.05$) had performed prior to 37th gestational week. (table 1)

Boys constituted 60% of the cases, 82.2% of the cases had birth weights < 2500 grams ($p < 0.05$).

A.P.G.A.R scores had found to be generally normal in 16 cases (22.2%), while the rest who had low A.P.G.A.R scores showed critically low scores (< 3) in 36 cases (49.3% of all cases), fairly low scores (4-6) in 21 cases (28.8%).

In the delivery room, 29 cases (39.7%) had treated with Continuous Positive Airway Pressure (C.P.A.P) (3 of them had receiving

C.P.A.P at time of diagnosis), whereas 8 cases (11.1%) underwent intubation, Positive Pressure (P.P.V) of whom one had extubated, treated with C.P.A.P by time of evaluation.

All the cases had symptomatic; so, conservative treatment had not undertaken with any of the cases. Cases clinically represented themselves by dyspnea, tachypnea, and/or progressive Respiratory Distress Syndrome (R.D.S). Clinical examination, chest radiographs revealed 38 (52%) right, 30 (41%) left, bilateral involvement in 5 (6.8%) of the cases. Postnatal age at time of diagnosis ranged from 13 hours to 22 days (median = 9 days), one case had Down syndrome, all cases enrolled had singletons.

Primary had considered in 22 cases (30.1%), while 51 cases (69.9%) had secondary to a previous pathology; meconium aspiration in 24 cases (32.8%), pneumonia in 20 cases (27.3%), supplementary diagnostic tools i.e. C.T., ultrasonography revealed pulmonary interstitial emphysema in 5 cases (6.8%), 2 case (2.7%) of disease.

Clinical evaluation in disease cases showed abnormal findings, concomitant congenital anomalies. One case had P.D.A, hypospadias, hare lip, the other presented with jaundice, umbilical hernia, abnormal skin turgor, in turn decision had done to subdue both to a chromosomal study that revealed an otherwise normal finding in the former, chromosomal abnormalities involving mostly chromosome 7, consistent with fibrosis in the later.(table 2)

Chest tube drainage had employed in 63 cases (86.6%) with severe symptoms and/or large jet

black areas. Tubes had inserted usually in the fifth intercostal space at the mid-axillary line, clinical improvement as well as radiographic evidencse of a reexpanded marked the time of chest tube removal. Chest tubes had inserted for a maximal of 6 days before removal.

In 6 cases (8.9%), small in chest radiographs, mild clinical data had found. So, thoracocentesis had adopted; however, it had critical in 2 cases (33.3% of the mild) as concluded from monitoring the cases, serial X-ray films. The remaining 4 cases, in whom thoracocentesis had failed to treat underwent chest tube insertion.4 cases underwent thoracotomy as they showed continuous leak in the I.C.T for more than one weak,2 cases had disease with huge apical bullae, 2 cases with bronchopleural fistula as a complication of pneumonia.

Along the course of treatment of 6 cases (8.9%) passed away including: the fibrosis case, the other with disease who developed interactable pulmonary hypertension, convulsions that led eventually to his demise. Mortlity cases included also 3 intubated cases on mechanical ventilation, one of the bilateral cases. All deceased participants had the outcome of C.S. prior to 37 weeks of gestation, of birth weights < 2000 grams, of male gender with A.P.G.A.R scores < 3, all mortalities took place within 10 days postnatally.(table 3)

The rest of the enrolled cases completed their treatment course safely, all of them had discharged in a period ranging from 13 to 42 days (median = 19 days).

Table (1): demographic, perinatal data

Maternal age	No (73)	%
Above 30	55	75.5%
Below30	18	24.5%
Mood of delivery	NO(73)	
Emergency section	19	26.6%
Section	47	64.4%
Vaginal	7	9%
SEX	NO (73)	
Female	29	40%
Male	44	60%

Birth wieght<2500	N0(73)	
Low	60	82.2%
High	13	17.8%

Table (2): characterization, clinical data

A.P.G.A.R score	No (73)	%
Normal	16	22%
Fairly low	21	28.8%
Very low	36	49.3%
Ventilation	NO(73)	
C.P.A.P	29	39.7%
P.P.V	8	11%
Diagnostic CXR	NO(73)	
RT	38	52%
LT	30	41%
Bilateral	5	6.8%
Type	NO(73)	
1ry	22	30.1%
2ry includes:		
Meconium aspirate	24	32.8%
Pneumonia	21	27.3%
Emphysema	5	6.8%
disease	2	2.7%

Table (3): prognosis, treatment

	NO (73)	%
Mortality	6	8.9%
Hospital stay	Mean 19 days	
Treatment	NO(73)	
Thoracocentesis	6	8.9%
I.C.T insertion	63	86.3%
Thoracotomy	4	5.4%

Abb, ICT:intercostal chest tube

DISCUSSION

Cases which might start with the first breath occurs in almost 1-2% of the population⁽¹⁾. The estimated critical of varies from 0.3% to 1.3% based on clinical symptoms or on radiological findings respectively[1].

Mortality rate in our series of cases had 8.9%, a markedly lower rate than those mentioned in previous works [9]. The rate of mortality varies

between reviews. However, information on whether P.T had the cause of death had only been presented in one other study, which also found no cases of death caused by P.T [10]. This could indicate that the risk of dying as a direct result of cases P.T might be lower than the current understanding.

Lungs had not fully expanded during initial breath in 2% of case cases, increasing pulmonary pressure causing alveolar rupture, passage of along interalveolar septa to pleural space [11]. Where no identifiable cause had found, might be attributed to a sub pleural bleb[18] or from uneven distribution of inflating pressures among gatherings of alveoli[12].

Our findings had conformable with Greenough A et al. [13] that secondary had more common than idiopathic in cases which had a much lower mortality rate (no mortalities in the primary gathering in our study). Meconium aspiration followed by pneumonia had the most common primary pathologies upon which secondary spontaneous developed, which had consistent with an antecedent study [14].

Parenchymal destruction, proximal airway obstruction producing episodic had of bad prognosis in fibrosis, which had found in one of the deceased cases within 10 days postnatally coinciding more or less with Ali R, Ahmed S et al. [15]. Prematurity, underlying diseases, low birth weight, mechanical had the major risk factors of in N.I.C.U admissions. All positive pressure modes play an important role in the etiology ,Prolonged inspiratory time, high mean airway pressure, poor case synchronization with the ventilator, continuous positive airway pressure had other etiologic factors [16].

Maximal peak inspiratory pressure, the number of suction procedures had also associated with in low birth weight cases [17]. Furthermore, cesarean section had shown to be a predisposing factor for cases related to catecholamine discharge in some reviews [18]. In concordance with previous works [2,16,17], we noted that male gender had more tendency to develop cases raising claims that an X-linked genetic element might be involved. Moreover, we could emphasize that male sex might be a risk factor for mortality with cases since all the deceased in this study had males.

The current research disclosed different maternal factors precipitating the development of cases including: a critical relevant old maternal age, highly critical association with

C.S. deliveries in which it had critical related to C.S. than emergency C.S., a finding congruent with other reviews [3,18], again method of delivery in all mortality cases had C.S[18].

Highly critical statistical relationships existed in our study between preterm labors < 37 weeks of gestation along with low birth weights < 2500 grams as well as low A.P.G.A.R scores, the critical other than mortality of cases . Increased critical of in lower gestational age had mostly caused by immaturity of parenchyma, due to lack of surfactant, high surface tension causing “air capture” with first breath in alveoli resulting in their rupture, besides a coincident broncho pulmonary dysplasia could intensify the condition [12]. One interesting finding had that a large majority of the cases had ≤ 24 h of age at debut of respiratory symptoms, none had > 48 h of age. It had been well known since long before the introduction of surfactant therapy that cases P.T presents later in preterm cases than in term cases. For example, one study from 1959 reported that cases P.T had an average symptom onset of 24 days in cases weighing < 1500 g while term cases debuted early after birth [12].

Preterm cases had more apt to hemodynamic changes at time of resulting in abrupt increase in cerebral blood flow with consequent development of a fatal Intraventricular Hemorrhage (I.V.H) specially those who received C.P.A.P in delivery room or aggressively underwent P.P.V [19]; unfortunately, one premature mortality case in our series with history of C.P.A.P treatment had convulsions, although I.V.H had suspected, diagnosis could not be confirmed as autopsy had not allowed. The remaining 3 mortality cases had intubated, receiving P.P.V [20].The previous finding us to urge the neonatologists to cease inadvertent C.P.A.P, P.P.V, in the same time, they drew our attention to two shortcomings of our study; first, the deficiency of means to determine the timing of onset specially in the primary cases; second, the lack of an expectatn treatment protocol of in our series comprising surfactnat, using

synchronized or volume ventilation, high rate, low-tidal-volume to decrease the critical of specially primary subtypes[4]; a method provided its efficacy in a previous limited cohort study[19]. Although the care of preterm cases had improved tremendously in the decades since, the timing of onset had only been described once in the post-surfactant era[21].

Our finding of critical differences in A.P.G.A.R scores between preterm, term/post-term cases suggests that preterm cases develop P.T as a complication of premature birth while term/post-term cases develop P.T as a complication of asphyxia. Unsurprisingly, preterm subjects had a later onset of symptoms, a higher critical of respiratory distress syndrome. Preterm cases more often received invasive treatment, as had been previously reported [22].

The goal of treatment should be to evacuate the from the pleural space, ensure complete pulmonary re-expansion, restore respiratory mechanics[23].

Although some literature states that there had no need for intervention in almost half of all primary cases case without any obvious disease, Nevertheless, it should be kept in mind that fearing complications of thoracocentesis (T.T.), waiting for more clinical deterioration might be more harmful. TT complications, especially with classic large-bore T.T, had critical mentioned in the literature (e.g., hemorrhage, parenchymal laceration, damage to breast tissue, damage to deeper structures or infection) [23]. When the efficacy of small-bore catheters had recognized, pigtail catheters, catheters with trocar needles started to be used in many centers with great success [23].

Overshadowed by chest tube, thoracocentesis had limited success in our series even with small isolated. Chest tubes had successfully, safely employed in the enrolled cases without any complication nor injury to an intrathoracic structures [24].

Thoracostomy had proved critical in draining in this gathering of cases as it provides better suction of from pleural space, closure of the

place through which had penetrated [25]. In our study 4 cases underwent thoracotomy as they showed continuous leak in the I.C.T for more than one week, 2 cases had disease with huge apical bullae, 2 cases with bronchopleural fistula as a complication of pneumonia.

A mortality of 10% to 43% with cases had been reported by various reviews; **Santos** et al. [12] 40.8%. Mortality often depends on other underlying factors rather than . It had a predictable outcome that this rate had higher among with V.L.B.W, preterm cases. Mechanical necessity, V.L.B.W, prematurity, intraventricular hemorrhage, chronic diseases, sepsis had the major causes of mortality [25].which had concordant with our study.

CONCLUSIONS

From this study, cases were mainly secondary to an underlying pathology. Cases of older mothers, C.S., male sex, premature cases with low birth weights, critically low A.P.G.A.R scores, those receiving C.P.A.P or P.P.V after delivery, those with primary disease had more prone to develop spontaneous pneumothorax. Chest tube is a safe, successful solution for cases .

CONFLICT OF INTEREST: Non

FINANCIAL DISCLOSURES: Non

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