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Service de Néonatologie

Incidence and management of neonatal pneumothorax in a 10-hospital regional perinatal network in Switzerland: A retrospective observational study

THESE

préparée sous la direction de Madame la Professeure Anita C. Truttmann

et présentée à la Faculté de Biologie et de Médecine de
l'Université de Lausanne pour l'obtention du grade de

DOCTEUR EN MEDECINE

par

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Julie Dan-Vi BAUDAT-NGUYEN

intitulée

Incidence and management of neonatal pneumothorax in a 10-hospital regional perinatal network in Switzerland: A retrospective observational study

sans se prononcer sur les opinions exprimées dans cette thèse.

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Lausanne, le 30.01.2024

pour Le Doyen
de la Faculté de Biologie et de Médecine

Monsieur le Professeur John Prior
Vice-Directeur de l'Ecole doctorale

Incidence et prise en charge du pneumothorax néonatal au sein du réseau néonatal romand suisse: une étude observationnelle rétrospective

Le pneumothorax est une entité bien connue qui touche principalement les nouveau-nés, avec une incidence variant entre 0.05 et 2% des naissances selon la littérature. Plusieurs approches dans le traitement du pneumothorax néonatal existent sans consensus clair. Les options comprennent le traitement conservateur, l'exsufflation avec aiguille et le drainage thoracique.

Les soins en néonatologie en suisse romande, à l'exception de Genève, sont organisés depuis 20 ans au sein d'un réseau périnatal régional, englobant à peu près 14000 naissances par année. Selon la classification CANU (Committee for the Accreditation of Neonatal Units),les lits de néonatologie sont distribués en 1 hôpital universitaire de niveau III avec une unité de soins intensifs, 3 hôpitaux de Niveau IIB et 6 hôpitaux de niveau IIA. Ils sont classés selon leur infrastructure, équipement et effectif de médecins néonatologues.

L'objectif primaire de cette étude a été de définir l'incidence du pneumothorax au sein du réseau néonatal sur une période de 30 mois (01.07.2016-31.12.2018), et les objectifs secondaires d'identifier les facteurs de risques du pneumothorax, de comparer les différents traitements du pneumothorax en terme de taux de réussite et d'échec, d'éventuelles complications recensées, de nombre de radiographie de thorax effectuées et de la durée du séjour hospitalier.

Notre étude a inclus 173 nouveau-nés, dont 130 (75%) étaient des garçons et 140 (81%) nés à terme. L'âge gestationnel médian était de 39.6 (27.1-42) semaines et le poids de naissance médian de 3180 (870-4410) grammes. L'incidence globale du pneumothorax néonatal dans notre réseau était de 0.56 par 100 naissances (0.12-1.24) avec une grande variabilité entre les centres. 39% des pneumothorax étaient traités de manière conservative, 41% par un drainage thoracique, 13% par une exsufflation et 7% par une exsufflation suivie d'un drainage thoracique ou vice versa. Le taux d'échec était significativement plus élevé pour les patients traités par exsufflation (37%) que par drainage thoracique (9%). Cependant, le nombre de radiographies de thorax et la durée d'hospitalisation en jours étaient significativement moins importantes pour les patients traités par exsufflation que pour les patients traités par drainage thoracique. Les complications, dont les apnées, la rétention urinaire en lien avec l'administration de morphine, la malposition du drain ou sa dysfonction et les complications locales de l'orifice du drain touchaient 1/3 des patients drainés et zéro des patients exsufflés.

Cette étude a permis de mettre en évidence une grande discrépance de l'incidence du pneumothorax entre les différents centres du réseau. L'exsufflation semble être une approche prometteuse du fait d'un meilleur outcome en termes de nombre de radiographies de thorax, de durée d'hospitalisation, et de risque de complications. Grâce à cette étude, un nouvel algorithme de prise en charge du pneumothorax a été élaboré, afin d'harmoniser la prise en charge au sein du réseau néonatal romand.

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Original Article

Incidence and Management of Neonatal Pneumothorax in a 10-Hospital Regional Perinatal Network in Switzerland: A Retrospective Observational Study

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Abstract

Objective Pneumothorax (PTX) is a potentially life-threatening condition that affects neonates, with an incidence of 0.05 to 2%. Its management includes conservative treatment, chest tube (CT) drainage, and needle aspiration (NA). Aims were to evaluate the incidence of PTX in a 10-hospital perinatal network, its clinical characteristics and risk factors, and to compare the different treatment options.

Study Design All neonates diagnosed with PTX and hospitalized in the network were included in this retrospective observational trial over a period of 30 months. Primary outcome was the incidence of PTX. Secondary outcomes were the treatment modality, the length of stay (LOS), and the number of chest X-rays.

Results Among the 173 neonates included, the overall incidence of PTX was 0.56 per 100 births with a large range among the hospitals (0.12–1.24). Thirty-nine percent of pneumothoraces were treated conservatively, 41% by CT drainage, 13% by NA, and 7% by combined treatment. Failure rate was higher for NA (37%) than for CT drainage (9%). However, the number of X-rays was lower for patients treated by NA, with a median of 6 (interquartile range [IQR] 4–6.25), than by CT drainage, with a median of 9 (IQR 7–12). LOS was shorter for NA than for CT drainage, with a median of 2 (IQR 1–4.25) and 6 days (IQR 3–15), respectively.

Keywords
- pneumothorax
- incidence
- neonate
- chest tube drainage
- needle aspiration
- hospital network

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Complications, including apnea and urinary retention, occurred in 28% of patients managed with CT drainage, whereas none was observed with NA.

Conclusion High variability of PTX incidence was observed among the hospitals within the network, but these values correspond to the literature. NA showed to reduce the number of X-rays, the LOS, and complications compared with CT drainage, but it carries a high failure rate. This study helped provide a new decisional management algorithm to harmonize and improve PTX treatment within our network.

Key Points

- Neonatal pneumothorax (PTX) is a frequent pathology with a high incidence requiring urgent management.
- We report a large variability of PTX incidence between different hospitals of the same network.
- Needle aspiration carries higher failure rate, shorter hospital stay duration without complications reported.

Neonatal pneumothorax (PTX) is a life-threatening condition that occurs in 0.05 to 2% of all newborns[1–3] and up to 9% in very preterm infants.[4] It is defined as a collection of air within the pleural space, due to rupture of over-distended alveoli. PTXs are classified as spontaneous (primary or secondary) or iatrogenic (caused by positive airway pressure or a surgical procedure). A primary spontaneous PTX occurs in the absence of any obvious cause, whereas a secondary spontaneous PTX is associated with an underlying lung disease, such as transient tachypnea of the newborn (TTN), respiratory distress syndrome, or meconium aspiration syndrome (MAS).[1]

Numerous risk factors for developing PTX have been described including prematurity, very low birth weight (VLBW) (<1,500 g), male gender, cesarean section, meconium-stained amniotic fluid (MSAF), underlying pulmonary disease, invasive and noninvasive respiratory support.[5–9]

Several approaches in the management of neonatal PTX exist, namely, conservative treatment, chest tube (CT) drainage, and needle aspiration (NA),[10–12] while other techniques, such as nitrogen (N_2) washout, have been abandoned.[13,14] NA or needle thoracentesis is performed with an over-needle catheter or a butterfly needle inserted between the second and third ribs in the mid-clavicular line that evacuates air and is immediately removed once there is no more air to be aspirated.[15] CT drainage implies the insertion of a tube (Charrière size 8–12) between the fourth and fifth ribs in the anterior axillary line to allow drainage of air and left in situ. So far, few recommendations have been established.[10] For management of primary spontaneous PTX in adults, NA is the treatment of choice,[16,17] as it is considered as effective and safe as CT drainage, and it results in fewer hospital admissions and shorter hospital stay.[18] In neonatology, treatment depends on the experience and habits of the medical staff in charge of the patient. The choice of treatment may have an impact on the number of chest X-rays, the hospital stay duration, and possible complications.

In the French-speaking part of Switzerland (excluding Geneva), neonatal care has been organized as a perinatal regional network for over 20 years, with an actual pool drained of around 14,000 live births per year.[19] The neonatal beds are distributed in one tertiary center, with a level III neonatal intensive care unit (NICU) (Centre Hospitalier Universitaire Vaudois [CHUV], Lausanne), and nine secondary centers that are divided into level IIB ($n = 3$) and level IIA ($n = 6$), depending on available infrastructure, equipment, and staffing (center of accreditation of neonatal units criteria, according to the Swiss Society of Neonatology).[20] There are also two level I private clinics with a maternity ward, but without specific neonatal beds, and therefore, they were not included in our analysis.

The main objective of the study was to evaluate the incidence of PTX in the perinatal network of the French-speaking part of Switzerland and in each individual center within the network. The secondary objectives were to describe the clinical characteristics, identify the risk factors, and compare management and outcome depending on the treatment of PTX, in order to improve and standardize education, management, and transfer criteria among the 10-hospital regional perinatal network.

Methodology

This retrospective observational study included all newborns hospitalized in 1 of the 10 centers of the perinatal network in the French-speaking part of Switzerland (Lausanne, Aigle,* Fribourg, Morges, Neuchâtel, Nyon, Payerne, Sion, Vevey,* Yverdon) between July 1, 2016, and December 31, 2018, with a diagnosis of PTX. In all cases, the diagnosis of PTX was based on signs of respiratory distress (tachypnea, nasal flaring, retractions, grunting, and/or cyanosis) and confirmed by chest radiography. PTX could not be classified as spontaneous or iatrogenic, since X-ray was not performed systematically before initiating manual ventilation or nasal continuous positive airway pressure (nCPAP). The study was approved by the local ethical

* *Reunification of Aigle and Vevey Hospitals under the name of Riviera-Chablais Hospital, opened in 2019.*

committee of the Canton de Vaud (Project ID: 2019-00462).

The data were collected from the hospital electronic clinical database and medical records in all 10 hospitals of the regional network. These data included gestational age (GA), birth parameters, gender, type of delivery, amniotic fluid staining, Apgar score at 1, 5, and 10 minutes, umbilical cord pH, resuscitation type, use of respiratory support (high-flow cannula, nCPAP, and conventional mechanical ventilation). All chest X-rays were reviewed retrospectively for confirmation of PTX, and in case of doubt, reviewed anonymously by a neonatal expert. PTX characteristics were also obtained (side, tension PTX, type of management, and success and recurrence rates). Tension PTX was considered whenever a mediastinal shift was observed on chest X-ray or a patient presented hemodynamic instability. Time to diagnosis, number of chest X-rays per patient, length of stay (LOS), and potential complications were collected.

Suspected PTX on standard anterior–posterior (AP) chest X-ray could be confirmed by obtaining a lateral decubitus position projection.[21] In the aim of limiting radiation, it should only be used in the case of doubtful PTX on AP X-ray. In this study, the number of total chest X-ray images per patient was obtained and classified as "necessary" to make the diagnosis when the AP projection was not contributory and "unnecessary" in case of an obvious PTX on AP projection constituting, thereby, a redundant examination.

The exclusion criteria for the secondary objectives were patients with cardiac or pulmonary malformations, and patients with PTX which developed in postoperative care. Moreover, patients transferred to a tertiary hospital other than the CHUV have been included for incidence calculation but excluded for management evaluation.

All statistical analyses were performed using IBM SPSS for Windows, version 27. Categorical variables were evaluated by absolute and relative frequencies, and continuous variables were reported as median (interquartile range [IQR]). Chi-square or Fisher's exact test was used to compare categorical variables, when appropriate. A p-value < 0.05 was considered statistically significant.

Results

During a 30-month period, from July 1, 2016, to December 31, 2018, PTX was identified in 192 patients, of whom 8 were excluded (1 misdiagnosis and 7 born in centers out of the regional network) as shown in ►Fig. 1.

A total of 184 neonates with PTX born in 1 of the 10 centers of the regional perinatal network were included for a total of 32,746 live births during the 30-month period, which results in an overall incidence of 0.56 per 100 live births (range of 0.12–1.24 between hospitals) (►Table 1). Eleven patients were excluded due to congenital anomalies ($n = 5$), postsurgical management ($n = 2$), postnatal transfer to another other university hospital outside the network ($n = 4$), leaving a total number of patients of 173 for the analysis of the secondary objectives (see ►Fig. 1).

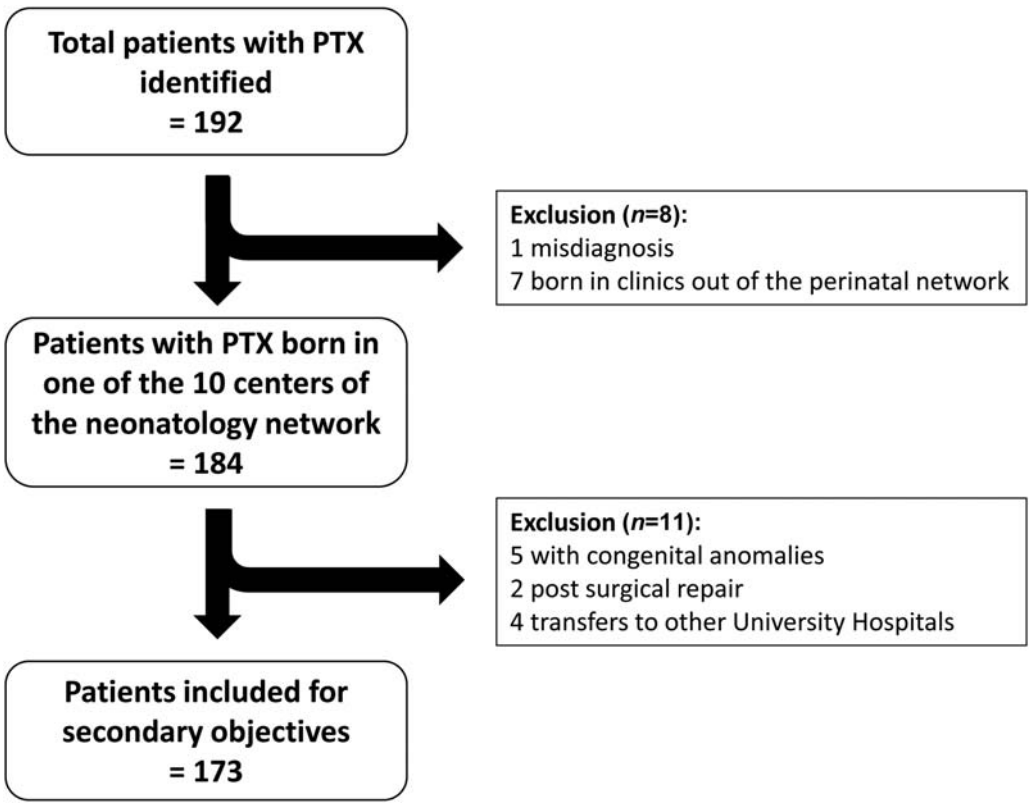

Fig. 1 Flowchart of included patients. PTX, pneumothorax.

Table 1 Incidence of PTX per 100 live births of each hospital from July 2016 to December 2018

Hospital	Level of hospital	*n* PTX	*n* births	% births
1	IIA	36	2,895	1.24
2	IIA	12	1,510	0.79
3	IIB	28	4,213	0.67
4	IIA	10	1,525	0.66
5	IIA	20	3,551	0.56
6	III	43	8,217	0.52
7	IIB	16	3,634	0.44
8	IIA	10	2,528	0.40
9	IIA	6	2,183	0.28
10	IIB	3	2,487	0.12

Abbreviation: PTX, pneumothorax.

Descriptive characteristics of the patients are presented in ►**Table 2**. Out of the 173 patients, 130 (75%) were male and 140 (81%) were born at term. Median GA was 39.6 (37.6–40.7) weeks, with three patients (1.7%) classified as very preterm (28–31.6 weeks) and one patient as extremely preterm (< 28 weeks). Median birth weight (BW) was 3,180 (2,805–3,590) g. Type of delivery was vaginal (with or without instrumentation) in 102 (59%) patients and cesarean section (emergency or elective) in 71 cases (41%). More details are found in ►**Table 2**. Resuscitation maneuvers (manual bag ventilation, Neopuff, or nCPAP) during neonatal adaptation before chest X-ray were performed in 121 (70%) neonates with PTX, whereas 52 (30%) did not require resuscitation, except for receiving oxygen by mask for 8 patients. Twenty percent of all patients had a diagnosis of an underlying pulmonary disease, such as MAS, amniotic fluid or blood aspiration syndrome, and TTN. Of the 173 patients with PTX diagnosed, 39 were born in the tertiary hospital (subsequently referred to as "inborn"), and the others in one of the nine level II hospitals, of those, 75 (56%) had to be transferred to the only tertiary NICU within the network (patients referred to as "outborn").

A total of 1,359 radiological images were performed, with a median of 7 per patient (4–10.5), of which 88 (6.5%) were considered unnecessary (33 profile X-rays and 55 unnecessary decubitus lateral views).

Among the 173 patients, a majority of cases (85%) were diagnosed with PTX within the first 4 hours of life (►**Table 3**). Eleven neonates (6.4%) required invasive ventilation prior to diagnosis, 45 (26%) were on nCPAP, 12 (6.9%) on high-flow nasal cannula, and 105 (60.7%) did not need any respiratory support, except for oxygen by mask for 8 patients. Almost two-thirds ($n = 106$) of PTX were only right sided, 23% ($n = 39$) were only left sided, and 16% ($n = 28$) were bilateral, resulting in a total number of 201 PTX. In first intention, as showed in ►**Fig. 2**, CT drainage was applied in 83 (41.3%) PTXs, NA in 27 (13.4%), and conservative treatment in 78 (38.8%), of which 4 neonates were managed with 100% oxygen in a head box (N_2 washout). A combination of the two approaches (NA followed by CT drainage or vice versa) was applied in 27 (6.5%) PTXs.

►**Table 3** shows the clinical data regarding the PTX management (CT drainage, NA, and conservative treatment). We found no statistical significance between the three groups of patients, regarding GA, birth parameters, delivery mode, resuscitation maneuvers at birth, umbilical cord pH, Apgar score, uni- or bilateral PTX. However, we found that tension PTX on X-ray ($p = 0.0034$), invasive mechanical ventilation before treatment ($p = 0.0007$) and underlying pulmonary disease ($p = 0.0012$) were associated with CT drainage. On the opposite, no respiratory support and/or O_2 by open mask at the time of diagnosis and independently of resuscitation maneuvers negatively associated with CT drainage ($p = 0.0052$). As shown in ►**Table 4**, failure rate was significantly different between PTX treated with CT drainage (8/85, 9%) and with NA (14/38, 37%). ►**Fig. 3** shows the details of the treatment of each PTX. Of the PTX that needed second-line treatment after NA, 9/38 (24%) were treated by CT drainage, 3/38 (8%) got a second NA, and 2/38 (5%) a second NA followed by a CT drainage. The CT drainage group required a higher number of X-rays with a median of 9 (7–12) compared with the NA group, with a median of 6 (4–6.25) ($p < 0.001$) and the conservative treatment group with a median of 3 (2–6) ($p = 0.004$). The duration of the hospital stay was significantly longer in the CT drainage group, with a median of 6 (3–15), than in the NA group with a median of 2 (1–4.25) or in the conservative treatment group with a median of 3 (2–5). Complications such as apnea ($n = 7$), urinary retention due to morphine use ($n = 9$), drain malposition/dysfunction ($n = 7$), and drain orifice local complications such as infection and wound dehiscence ($n = 4$), occurred in 28% (25/89) of patients with CT drainage, whereas no complications were observed in the two other groups. No neonatal deaths occurred in any of the treatment groups.

Discussion

This study aimed to define and compare the incidence of PTX in a 10-hospital regional perinatal network in the French-

Table 2 Demographic and perinatal data of newborns diagnosed with PTX ($n = 173$)

Gender ratio (M:F)	3:1
GA (wk), median (minimum–maximum)	39.4 (27.1–42)
> 37 GA, *n* (%)	140 (80.9)
32–36.6, *n* (%)	29 (16.8)
28–31.6, *n* (%)	3 (1.7)
24–27.6, *n* (%)	1 (0.6)
BW (g), median (minimum–maximum)	3,180 (870–4,110)
> 2,500 g, *n* (%)	149 (86.1)
1,500 g–2,499 g, *n* (%)	20 (11.6)
< 1,500 g, *n* (%)	4 (2.3)
Type of delivery, *n* (%)	
Vaginal delivery	102 (59)
Forceps	13 (7.5)
Vacuum	24 (13.9)
C-section	71 (41)
Amniotic fluid at birth, *n* (%)	
Meconium-stained	30 (17.3)
Clear	143 (82.7)
Apgar score, median (minimum–maximum)	
1 min	7 (0–10)
5 min	8 (2–10)
10 min	9 (6–10)
Arterial cord pH, median (±SD)	7.24 (±0.11)
Venous cord pH, median (±SD)	7.31 (±0.09)
Type of resuscitation at birth, *n* (%)	
None/oxygen given by mask	52 (30)
Manual ventilation/nCPAP	121 (70)
Diagnosis of underlying pulmonary disease, *n* (%)	
Yes	37 (20.8)
No	136 (79.2)
Birth hospital, *n* (%)	
CHUV (inborn)	39 (22.5)
Other centers	134 (77.5)
Transfer to CHUV (outborn)	75/134 (56)

Abbreviations: BW, birth weight; CHUV, Centre Hospitalier Universitaire Vaudois; F, female; GA, gestational age; M, male; nCPAP, nasal continuous positive airway pressure; PTX, pneumothorax; SD, standard deviation.

Table 3 Clinical characteristics of patients ($n = 173$)

Timing of diagnosis in h, *n* (%)	
< 4 h of life	147 (85)
From 4 to 24 h of life	22 (13)
> 24 h of life	4 (2)
Type of respiratory support before diagnosis, *n* (%)	
Invasive ventilation	11 (6.4)
Noninvasive ventilation	45 (26)
High-flow nasal cannula	12 (6.9)
None/O_2 by open mask	105 (60.7)
Laterality, *n* (%)	
Right	106 (61.3)
Left	39 (22.5)
Bilateral	28 (16.2)
Tension PTX, *n* (%)	29/173 (16.8)
Total number of X-ray, *n* (%)	1,359 (100)
Necessary	1,271 (93.5)
Unnecessary	88 (6.5)
Decubitus lateral projection	55 (4)
Profile	33 (2.5)

Abbreviation: PTX, pneumothorax.

speaking part of Switzerland over a period of 30 months. Furthermore, we aimed to identify risk factors and to compare management strategies and patient outcomes, in order to standardize and improve medical care within the network.

The first interesting observation was an overall high incidence of PTX with a large variability among centers, varying by a factor of 10. The numbers still correspond to data in the literature with a reported incidence of 0.05 to 2% of live births.[1,2] However, the overall incidence of PTX in our study may be underestimated, due to different detection thresholds and no systematic X-ray at birth. The variability among our network might be explained by several factors: (1) the neonatal levels of care (IIA, IIB, or III) and the experience of the health professionals, (2) the number of deliveries, and (3) the differences in the delivery room (DR) management. While we did not highlight differences in PTX incidence based on the level of care of the hospitals and the critical mass, application of different ventilation devices in the DR turned out to be of concern in at least one hospital.

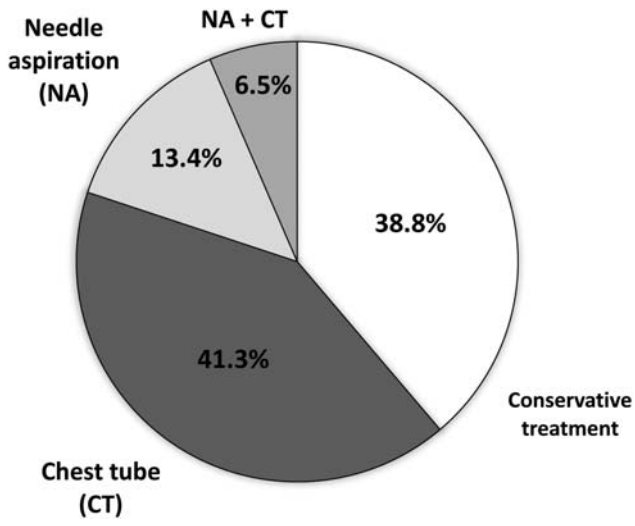

Fig. 2 Treatment of pneumothorax ($n = 201$).

Table 4 Comparison between treatment options of PTX management

	Chest tube drainage	Needle aspiration	Conservative treatment
Failure rate[a], *n* (%)	8/85 (9)	14/38 (37)[b]	–
Number of X-rays[c], median (IQR)	9 (7–12)	6 (4–6.25)[b]	3 (2–6)[b]
Length of hospital stay[c] (d), median (IQR)	6 (3–15)	2 (1–4.25)[b]	3 (2–5)[b]
Complications[c], *n* (%)	25/89 (28)	–	–

Abbreviations: IQR, interquartile range; PTX, pneumothorax.
[a]Expressed per PTX instead of per patient.
[b]*p*-value <0.05 comparing chest tube drainage versus other.
[c]Expressed per patient.

Essentially two devices are used in DR management; the traditional bag valve mask (Ambu) and the Neopuff, a more recent neonatal resuscitation device using a T-piece allowing control of the peak inflating pressure (PIP) and the positive end-expiratory pressure (PEEP). The implementation of the Neopuff was identified in one hospital (with the highest incidence) to be a potential risk factor, linked to high PIP and PEEP initial settings. Onsite education was undertaken and settings were adapted. Moreover, the use of early nCPAP is clearly associated with an increased odds ratio of PTX.[22,23] In our network, six hospitals used nCPAP for newborns >34 GA before excluding PTX on X-ray, and this might have biased our findings.

Regarding the risk factors, we identified the same as described in the literature, such as male gender, resuscitation maneuvers at birth, and cesarean section.[6,7] For instance, PTX was 1.3 times higher following C-section compared with vaginal birth delivery and assuming an overall rate of 32% C-section for the studied period.[24]

We did not highlight differences in PTX incidence based on low BW, as well as MSAF, as described in the literature,[8,9] but this could be due to our small sample of patients. Only one out of five newborns with PTX had an associated diagnosis of underlying pulmonary disease such as TTN and MAS. The dominant side of PTX was the right (61% cases), as is often described in the literature[9,25] probably in relation with the largest lung or the anatomy of the main stem bronchus, favoring ventilation of the right side.

Regarding the diagnostic management, a median of seven X-rays per patient (4–10.5) were performed in our population, with a high rate of unnecessary images (profile and decubitus) as AP X-ray projection is considered the gold standard for respiratory distress in neonates.[26] Interestingly, we could not find any literature (pediatric or adult) reporting

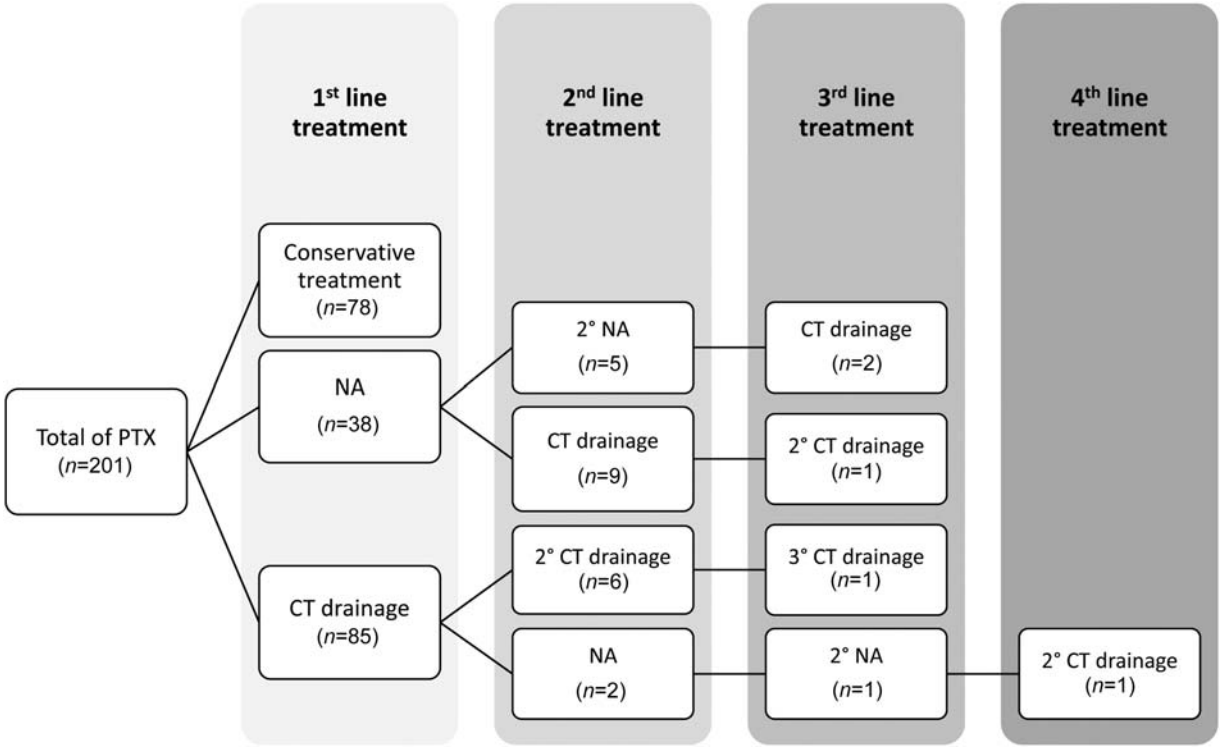

Fig. 3 Detailed management of PTX (*n* = 201). CT, chest tube; NA, needle aspiration; PTX, pneumothorax.

the radiation exposure linked to this pathology, which in fact can be considered as an important outcome indicator. At the time of the study, no unit was performing lung ultrasound, which is now emerging as a new diagnostic tool.[27]

Concerning neonatal PTX treatment, few recommendations exist so far. Commonly, conservative treatment is used for small and asymptomatic PTX, while either CT drainage or NA is applied for larger PTX and/or symptomatic patients with moderate/severe signs of respiratory distress.[12,28] We could identify two centers using the nitrogen washout approach while this procedure has no longer proved its efficacy and may even be deleterious.[13,14]

In our study, we identified three risk factors that are predictors of CT insertion: tension PTX on X-ray, invasive mechanical ventilation before treatment, and underlying pulmonary disease. Interestingly, Halibullah et al found similar results in a comparable population.[29] On the opposite, the absence of ventilation support or O_2 by mask was negatively associated with CT drainage. These findings may help determine the management of PTX in the future regarding the choice of treatment and give suggestions to develop new guidelines.

NA as primary intervention has been recently detailed in a Cochrane review, which shows limited evidence of its use,[10] based predominantly on only one randomized controlled trial.[11] As a matter of fact, we, along with others, have demonstrated that NA confers several benefits: (1) the hospital stay was significantly shorter,[11,18,30] (2) the number of X-rays was reduced (our study), and (3) no complications were reported.[30] Similar findings were described by Murphy et al,[11] as well as in studies in adults.[18,30] Furthermore, the postintervention surveillance could take place for selected patients in the maternity ward. Moreover, taking into account the lower medical burden for these newborns, social (separation from the mother) and economic factors might have been also positively impacted but out of the scope of our study.

However, an important drawback of this approach remains the high failure rate. In our study, NA had a significantly higher failure rate than CT drainage but interestingly, two of three of the patients were successfully treated with a single NA. These are better results compared with other studies, where the failure rate ranged from 70% in a retrospective study[29] and in a randomized study[11] to 89% in an observational study.[25]

The open question, which lacks an answer for now, is the comparison of NA versus conservative treatment. Nevertheless, from our results, we can speculate that NA would still be superior due to shorter LOS as well as the impact on psychological as well as economic factors. Therefore, in our opinion, NA seems to be of great potential, if a precise and strict indication algorithm is followed and skills for CT drainage are available on site.

Finally, it should be noted that, in our neonatal network, PTX was considered resolved on a basis of clinical criteria (normal respiratory rate, no respiratory distress signs, no dependence of oxygen) and not on a radiological basis. Patients were discharged 12 to 24 hours after ventilation support weaning (noninvasive ventilation, high-flow nasal cannula), and this does not significantly influence the LOS.

In terms of regional collaboration, we found surprisingly that more than half of the patients could have been successfully managed on site, avoiding the transfer to a higher level hospital. Despite the retrospective design, this study helped unveil differences in practice of resuscitation and respiratory distress management among a 10-hospital network, explaining partially the large variability in incidence.

Limitations

The main limitations of this study are the retrospective observational design, the lack of comparison between NA and conservative treatment, as well as the lack of detailed information about the symptoms of the patients with PTX and the potentially iatrogenic implications from positive pressure ventilation (PPV) in resuscitation room. There is also an unknown number, estimated about 1 to 2% of asymptomatic undiagnosed PTX in newborns[2] which may have misled the incidence rate. We compared three groups of treatment in a heterogeneous population, which implicates a selection bias. For this area of research, a prospective, randomized, and matched group (for symptoms and size of the PTX) controlled trial would be required.

Conclusion

Our retrospective study analyzed a population of 173 patients with PTX, that is, to our knowledge, one of the largest sample sizes compared to the existing literature.[29] We found an incidence of 0.56 PTX per 100 live births compared with 0.05 to 2% in the literature. We found the same risk factors, such as male gender, resuscitation maneuvers at birth, and cesarean section. Similar management approaches, meaning conservative treatment, CT drainage, and NA were used with the same outcomes. We identified NA as a safe treatment option, implicating less exposure to radiation as well as shorter hospital stay. In this study, failure rate was three times higher for NA than for CT drainage but still much lower than other studies. Nevertheless, and according to previous studies, there is insufficient evidence to promote one treatment over another and randomized trials are required.

Following the analyses of our study, a new decisional management algorithm to standardize the management of PTX is currently implemented in the network and will contribute to improve care of neonates born in the French-speaking part of Switzerland.

Conflict of interest

None declared.

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