ORIGINAL ARTICLE

Chest radiographs after removal of chest drains in neonates: clinical benefit or common practice?

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Background: Chest drain insertion is a common procedure in neonatal care. Routine radiography after removal of chest drains increases radiation exposure, handling and cost, but there are few data proving clinical benefit.

Objectives: To review current practice and determine the yield of routinely obtained chest radiographs (CXR).

Methods: A retrospective chart review of all infants undergoing removal of chest tubes in a single tertiary neonatal unit in New Zealand between January 1998 and July 2004 was performed.

Results: In total, 119 infants were identified, from the database, to have a chest drainage performed. In 19 cases, the procedure was needle aspiration or the drain was removed outside of our unit, hence these were excluded. The remaining 100 patients with 110 episodes of chest drain removal after 174 chest tube insertions were analysed. In asymptomatic infants, routine radiography showed some reaccumulation of air in nine of 35 cases of pneumothorax or of fluid in two of the five cases of pleural effusion, but chest tube reinsertion was not required. In the 12 clinically symptomatic infants, chest tubes were reinserted in five cases (four reaccumulations of pneumothorax and one pleural effusion), and one infant had symptomatic right upper lobe collapse. In the remaining infants, there were no abnormalities on CXR accounting for deterioration.

Conclusions: Given the low yield for routine radiography after chest drain removal, we suggest that close observation is likely to detect clinically relevant recurrence of pneumothorax.

Chest-drain insertion and subsequent removal is a common procedure in neonatal care for treatment of pneumothorax, pleural effusions and after surgical interventions. In the Australian and New Zealand Neonatal Network, data from admissions to level III neonatal nurseries between 1999 and 2002 show an overall incidence of about 5% for reported air leak, requiring some form of drainage.¹ Routine practice is to obtain a chest radiograph (CXR) after performing a tube thoracostomy to confirm optimal placement and lung expansion.

Recurrence of pneumothorax and reaccumulation of pleural effusions are possible events after chest drain removal. In contrast with the routine practice for chest tube insertion, the management of chest drain removal varies. There are three different approaches in the clinical setting. Firstly, the chest drain is clamped for a period of time before removal to "test" the situation; secondly, a CXR after the chest-drain removal is obtained to assess for possible reaccumulation; and thirdly, the chest drain is removed under close monitoring of the clinical status.

Routine CXR after chest drain removal increases radiation exposure, handling and cost, but there are few data proving clinical benefit. Several retrospective studies in adults conclude that CXR after chest tube removal should not be routinely carried out as it shows no benefit over clinical judgement.^{2–4} A prospective study regarding mechanically ventilated patients showed that a single CXR 1 h after chest drain removal effectively identified recurrent pneumothorax; in this study, it seemed safe to remove chest drains in patients undergoing positive-pressure ventilation.⁵ Another prospective study showed no benefit from routine CXR after thoracocentesis among the adult population.⁶ In children who required thoracostomy tubes after cardiac surgery, a retrospective study showed that clinical signs and symptoms identified nearly all relevant pneumothoraces.⁷ Data from the neonatal population are lacking.

AIM

The aims of this study were to review current practice of chest drain removal at a tertiary neonatal unit in New Zealand and to determine the yield of routinely obtained CXR after chest-drain removal.

METHOD

A retrospective case note review was carried out on 119 neonates, identified as having a chest drain inserted, in a single tertiary neonatal unit in New Zealand during the period January 1998 to July 2004. Demographical and clinical data were extracted, including gestation, birth weight, diagnosis and data on chest drain insertion, such as date of insertion, date of chest drain removal and date of the first CXR after removal. In addition, CXR abnormalities reported by consultant radiologists, especially whether a pneumothorax was present, and signs and symptoms of respiratory distress, including increasing oxygen requirement, increasing carbon dioxide tension, increasing respiratory rate and decreased air entry on examination, were recorded.

The infants were grouped by indication for insertion (pneumothorax, pleural effusion and surgical), and by management at the time of the chest drain removal. Existing management strategies included (a) no routine CXR; (b) routine CXR regardless of symptoms; (c) CXR if symptomatic and pneumothorax or effusion suspected; and (d) chest drain clamped and CXR before removal.

RESULTS

In all, 119 charts were reviewed and 19 patients were excluded either because data on drain insertion or removal were not available or because chest drains had been managed outside of our neonatal intensive care unit. The remaining 100 infants had

Abbreviation: CXR, chest radiographs

Figure 1 Flow diagram for exclusion criteria.

174 chest drains inserted. The management of only 110 episodes of chest drain removal is presented, as in 42 cases the drain was removed for repositioning or bilateral drains were removed in the same episode, and another 22 chest drain episodes were excluded, as the infants had died before chest drain removal (fig 1).

The median gestational age of the 100 infants reported was 33.5 (range 24–41) weeks and median birth weight was 2205 (range 490–4545) g. The indications for chest drain insertion ($n = 110$ chest drain removal episodes) were 89 (81%) for pneumothorax (36 right, 46 left, 7 bilateral), 16 (15%) for pleural effusion, five (5%) for surgical indications (two general surgical and three surgical ligation of persistent ductus arteriosus). The median duration of the chest drain remaining in situ was 3 (range 1–25) days. The drain was documented as “clamped off” before removal for a median of 3.75 (range 2–16) h in 34 infants, of whom six became symptomatic, requiring the drain to be unclamped. In all, 56 (51%) episodes had no CXR taken after chest drain removal, 42 (38%) had a routine CXR performed, and 12 (11%) had a CXR performed for symptoms (table 1, fig 2).

Routine radiography showed a pneumothorax in nine of 35 (26%) episodes, but these were small and none required chest drain insertion; two of the five (40%) routine CXRs for pleural effusion had reaccumulation of their pleural effusion; none required a chest drain reinsertion. CXR were obtained in 12 infants who became clinically symptomatic, including increased oxygen requirement (10/12), increased respiratory rate (4/12) and decreased entry of air to lung fields (1/12).

Table 1 Comparison of chest drain indications and practice of taking chest radiographs

Indication for insertion	No routine CXR, n (%)	Routine CXR, n (%)	Symptomatic CXR, n (%)	Total
Pneumothorax	45 (51)	35 (39)	9 (10)	89
Pleural effusion	8 (50)	5 (31)	3 (19)	16
Surgical	3 (60)	2 (40)	0 (0)	5
Total	56 (51)	42 (38)	12 (11)	110

CXR, chest radiograph.

Figure 2 Comparison for chest drain episodes and chest radiographs (CXR) indications

However, chest tubes had to be reinserted in only five cases. Four required chest drain reinsertion for reaccumulation of pneumothorax and one required reinsertion for reaccumulation of pleural effusion. In the remaining symptomatic infants, one had a right upper-lobe collapse and the others had no identified explanation for deterioration. None of those infants was critically unwell.

DISCUSSION

This review shows a wide variation in current practice regarding CXR after chest drains removal, inserted for various indications, in newborns. Indeed, the practice guidelines for our unit have hitherto allowed for variation and preference.⁸ The yield of routine radiography regarding recurrent pneumothorax and subsequent chest drain insertion was relatively low, with no asymptomatic infant requiring drain reinsertion. By contrast, chest drain reinsertion was indicated in almost half of the infants with a CXR taken owing to symptoms identifying pneumothoraces. Thus, close clinical observation is likely to detect considerable pneumothorax reaccumulation. As the number of chest drains inserted after surgery or for pleural effusion was relatively small, there are inadequate data to recommend change in practice for these.

Although this review represents a large number of infants, there are some limitations, mainly because the data were collected retrospectively and there was a lack of detail in the documentation of insertion time, change and removal of chest drains, clamping of chest drains and timing of CXR after removal. This made specific data collection difficult, especially regarding timing of events. Indications for CXR were obscured by infants with chronic lung disease, where the opportunity to

What is already known on this topic

- In children who required thoracostomy tubes after cardiac surgery, a retrospective study showed that clinical signs and symptoms identified nearly all significant pneumothoraces.
- Data from the neonatal population are lacking.

What this study adds

- This study suggests that close clinical observation is sufficient to detect clinically relevant recurrent pneumothorax after chest drain removal, inserted for pneumothorax, in neonates.

obtain a CXR after chest drain removal was combined with the surveillance of the disease process.

Although CXR is a common procedure in neonatal care, it should be kept to a minimum. The radiation dose for a single CXR is low, but neonatal radiation exposure is associated with a small increase in the risk of later childhood cancer.⁹⁻¹⁰ Although the financial costs per study is relatively low, owing to the frequency, the savings over time may be important.

In summary, there is little evidence that CXR performed after chest drain removal are of clinical benefit. Moreover, the increased handling, radiation exposure and cost are other factors against routine CXR after chest drain removal in neonates. This study supports the trend that close clinical observation is sufficient to detect clinically relevant recurrent pneumothorax after chest drain removal, inserted for pneumothorax, in neonates.

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IMAGES IN NEONATAL MEDICINE

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Necrosis of the left buttock as a complication of umbilical catheterisation in neonatal resuscitation

Umbilical catheters are commonly used in neonates for long-term parenteral nutrition, reliable infusion of irritant drugs, measurements of blood pressure, drawing of blood samples or administration of fluids and drugs. The use of umbilical catheters is associated with complications. This case report once again emphasises this and describes the theoretical and pathological substrates of these complications.

During resuscitation of a neonate, a venous umbilical catheter was inserted, through which fluids and drugs were infused. Shortly after, a purple livid discoloration of the left buttock was seen (fig 1). An x ray showed malpositioning of the umbilical catheter, which was located in the artery, with the tip in the left internal iliac artery. The pathology report showed necrosis of the left labium majus in the lower lumbar area, with thrombi in branches of the internal iliac artery and focal necrosis of the vessel wall.

The origin of the necrosis is multifactorial. The catheter was erroneously inserted into the artery instead of the vein, probably owing to dilation of the arteries as a result of the severe asphyxia.¹ Instead of passing down the umbilical artery to the iliac artery into the aorta, the catheter entered the left internal iliac artery and occluded the inferior gluteal and internal pudendal arteries.² Thrombus formation, direct damage to the vessel wall and arterial spasm were enhanced by infusion of hypertonic solutions.³

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Figure 1 (A) Necrosis of the left labium majus. (B) The necrotic left lower lumbar area. Informed parental consent was obtained for publication of this figure.

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