Is high-concentration oxygen therapy more effective than targeted oxygen therapy in neonatal non-tension pneumothorax?
Gregory, Anna; Ewer, Andrew; Singh, Anju

License:
None: All rights reserved

Document Version
Peer reviewed version

Citation for published version (Harvard):

Link to publication on Research at Birmingham portal

Publisher Rights Statement:
Checked for eligibility 28/11/2018

This is an author accepted version of an article published in Archives of Disease in Childhood.
http://dx.doi.org/10.1136/archdischild-2018-315659

General rights
Unless a licence is specified above, all rights (including copyright and moral rights) in this document are retained by the authors and/or the copyright holders. The express permission of the copyright holder must be obtained for any use of this material other than for purposes permitted by law.

• Users may freely distribute the URL that is used to identify this publication.
• Users may download and/or print one copy of the publication from the University of Birmingham research portal for the purpose of private study or non-commercial research.
• Users may use extracts from the document in line with the concept of ‘fair dealing’ under the Copyright, Designs and Patents Act 1988 (?)
• Users may not further distribute the material nor use it for the purposes of commercial gain.

Where a licence is displayed above, please note the terms and conditions of the licence govern your use of this document.

When citing, please reference the published version.

Take down policy
While the University of Birmingham exercises care and attention in making items available there are rare occasions when an item has been uploaded in error or has been deemed to be commercially or otherwise sensitive.

If you believe that this is the case for this document, please contact UBIRA@lists.bham.ac.uk providing details and we will remove access to the work immediately and investigate.
Is high-concentration oxygen therapy more effective than targeted oxygen therapy in neonatal non-tension pneumothorax?

Anna Gregory,1 Andrew Keith Ewer,1,2 Anju Singh.1 *

1. Neonatal Unit, Birmingham Women’s and Children’s NHS Foundation Trust, Edgbaston, Birmingham, B15 2TG. UK.
2. Institute of Metabolism and Systems Research, University of Birmingham, B15 2TT UK.

*Corresponding Author: Dr Anju Singh, Neonatal Unit, Birmingham Women’s and Children’s NHS Foundation Trust, Edgbaston, Birmingham, B15 2TG

Email: anjusingh@nhs.net

Key Words: Neonatal pneumothorax, oxygen therapy

Word Count: 742
Clinical scenario

A term new born is admitted to the neonatal unit with positive pulse oximetry screen and tachypnoea. The respiratory rate is 70 breaths per minute but there are no other signs of respiratory distress. The pre-ductal pulse oximeter oxygen saturations (SpO₂) are 91% and post-ductal SpO₂ are 90% in room air. The baby is commenced on low-flow oxygen at 0.05 litres/min, which improves both pre-ductal and post-ductal SpO₂ to 95%. Following this, the baby undergoes a chest radiograph which reveals a left sided pneumothorax with no significant lung collapse or mediastinal shift. As this is an incidental finding and the baby shows no clinical or radiological signs of tension pneumothorax, you question the need to treat with higher concentration oxygen therapy as has previously been routine practice.

Structured clinical question

In term and late preterm neonates (≥34 weeks) with spontaneous pneumothorax (SP) without clinical or radiological signs of tension (patient), is high concentration oxygen therapy (intervention) more effective than oxygen titrated to maintain targeted SpO₂ (comparison) for resolution/ improvement of clinical symptoms (outcome)?

Search

A literature search on Medline took place on 15th March 2018 using the following terms: exp"INFANT/NEWBORN"/, OR (neonate* OR newborn* OR neonatal OR babies OR baby OR infant*), AND exp PNEUMOTHORAX/, OR (pneumothorax OR pneumothoracis OR pneumothoraces), AND exp"CONSERVATIVE TREATMENT"/, (conservative ADJ (management OR therapy OR treatment)). This returned 33 results. There were only 2 studies in neonatal population (Table 1) that looked at high concentration oxygen therapy versus targeted oxygen therapy or room air.

Commentary

Spontaneous pneumothorax is a common air leak syndrome with incidence of 0.05-2% in all live births. Management of neonatal pneumothorax is dependent on severity of signs and symptoms, air leak size and evidence of lung collapse and/or mediastinal shift on chest radiographs. For pneumothoraces that show no evidence of cardiorespiratory instability or chest radiograph suggesting tension, invasive procedures such as needle thoracocentesis and/ or chest drain placement are not routinely performed. There are a range of conservative management practices to manage neonates with non-tension pneumothorax which may include; observation only, oxygen therapy to maintain targeted SpO₂, non-invasive respiratory support, or the use of 100% inspired oxygen for ‘nitrogen washout’. Nitrogen washout is thought to help with resolution of pneumothorax by increasing the nitrogen absorption gradient from the extra-pulmonary space. However, there is concerning evidence in literature of detrimental effects of oxygen therapy secondary to free radical injury.

A retrospective review by Clark et al showed that 100% oxygen therapy until resolution of radiological pneumothorax, was no better than targeted oxygen therapy to maintain SpO₂ between 92-95%, in the treatment of symptomatic small to moderate pneumothoraces, with evidence of respiratory distress but no signs of tension. In the retrospective review, the use of 100% oxygen demonstrated significant prolonged need for oxygen therapy and time to establish full feeds. These neonates also had longer time to resolution of tachypnoea and hospitalisation, however this was not statistically significant. The authors stated that a prospective randomised control trial may not be ethical due to the potential
toxicity of 100% oxygen therapy and have recommended the use of oxygen to target accepted oxygen saturations.

The study by Shaireen et al\(^3\) included a larger sample size from multiple centres. Overall they showed no statistical difference in the time of resolution of symptoms and length of hospital stay of spontaneous non-tension pneumothorax for the three treatment groups classified as receiving high oxygen (>60% FiO\(_2\)), moderate oxygen (<60% FiO\(_2\)) or room air (21%). The retrospective cohort study showed that the neonates in the room air group did not have any clinical deterioration and therefore the authors have stated that room air may be as effective as high oxygen in resolution of spontaneous pneumothorax.

Through our review of available evidence, there is a lack of trials comparing different non-invasive strategies in non-tension SP, especially with regards to high oxygen concentration and targeted oxygen therapy. Only two studies specifically answered our clinical question. Overall, there is no evidence in the neonatal literature to support high concentration oxygen therapy in term or late preterm (≥34 weeks) neonates with non-tension pneumothorax, despite it being used commonly in practice.

**Clinical bottom line**

- High concentration oxygen does not show greater benefit over targeted oxygen therapy to help early resolution of neonatal non-tension pneumothorax and may potentially be harmful due to free radical damage (Grade D)
- Neonates who receive high oxygen therapy may take longer to establish feeds (Grade D)
<table>
<thead>
<tr>
<th>Citation</th>
<th>Study group</th>
<th>Study type (level of evidence)</th>
<th>Outcome</th>
<th>Key results</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clark et al² 2014</td>
<td>45 babies &gt;35 weeks gestation, with small to moderate spontaneous pneumothoraces (SP) that did not require chest tube drainage and/or ventilatory support; 100% oxygen therapy, nitrogen washout, group (NW) = 26 Versus Oxygen treatment with targeted pulse oximetry, conventional group (C) = 19</td>
<td>Retrospective cohort study (level 4)</td>
<td>Primary Outcomes: Time to resolution of respiratory distress and length of oxygen therapy Secondary Outcomes: time to full feeding and length of hospital stay</td>
<td>NW group versus C group Time to resolution of tachypnoea: 37 (±27) vs 20 (±26) hours (NS); Length of oxygen treatment: 21.3 vs 8 hours, P &lt; 0.001 (S); Time to full feeds: 44.1 ± 25.7 vs 29.5 ± 18.8 hours, P = 0.03 (S); Length of hospitalization: 4.35 ±1.96 vs 3.53 ± 1.68 (NS)</td>
<td>No advantages of 100% oxygen therapy as compared to oxygen saturation targeted therapy in SP</td>
</tr>
<tr>
<td>Shaureen et al³ 2014</td>
<td>92 term neonates with radiologically confirmed SP treated with; high oxygen concentrations (HO: FiO₂ ≥ 60%) = 27, moderate oxygen concentrations (MO: FiO₂ &lt; 60%) = 35, room air (RA: FiO₂ = 21%) = 30</td>
<td>Population based retrospective multicentre, cohort study (level 4)</td>
<td>Primary Outcome: Time to clinical resolution of SP Secondary Outcome: Length of hospital stay and treatment failure</td>
<td>The time to resolution of SP between the three groups, median (range 25th-75th percentile) for HO = 12 hr (8-27), MO = 12 hr (5-24) and RA = 11 hr (4-24), p = 0.5 (NS) Treatment failure: HO: 2, MO: 4, RA: 0, p 0.17 (NS) Length of Hospital Stay p 0.54 (NS)</td>
<td>Neonates treated with room air did not require supplemental oxygen during their admission and remained stable</td>
</tr>
</tbody>
</table>

NS = Non-significant,  S = Significant
References

2. Clark, S; Saker, F; Schneeberger, M; Park, E; Sutton, D et al. Administration of 100% oxygen does not hasten resolution of symptomatic spontaneous pneumothorax in neonates. Journal of perinatology: official journal of the California Perinatal Association; Jul 2014; vol. 34 (no. 7); p. 528-531.
3. Shaireen, H; Rabi, Y; Metcalfe, A; Kamaludeen, M; Amin, H; Akierman, A; Lodha, A. Impact of oxygen concentration on time to resolution of spontaneous pneumothorax in term infants: a population-based cohort study. BMC pediatrics; Aug 2014; vol. 14; p. 208.