**WORKSHEET for Evidence-Based Review of Science for Emergency Cardiac Care**

**Worksheet author(s)**

Benjamin J Stenson

**Date Submitted for review:**

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**Clinical question.**

For infants delivered at >=34 weeks gestation (P), is delivery by elective c-section under regional anesthesia (I) in comparison with unassisted vertex vaginal deliveries (C) associated with an increased risk of requirement for positive pressure ventilation by mask or by intubation during resuscitation (O)?

Is this question addressing an intervention/therapy, prognosis or diagnosis? New topic studying an intervention

State if this is a proposed new topic or revision of existing worksheet:

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**Conflict of interest specific to this question**

Do any of the authors listed above have conflict of interest disclosures relevant to this worksheet? No

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**Search strategy (including electronic databases searched).**

Sept 20th 2009. I reviewed all of the titles in the neonatal Cochrane reviews and in the pregnancy and childbirth reviews looking for studies that might give a measure of the number of infants who require resuscitation at birth by mask ventilation or intubation (O) according to whether they were delivered by caesarean section or vaginally. No appropriate reviews that reported the outcome were identified. One review compared caesarean section under general versus regional anaesthetic but did not contain data directly relevant to this PICO question and was excluded.

I searched Medline (Pubmed) and Embase using a series of broad search terms that gave a large number of hits. I restricted all the searches to human studies with abstracts. I then reviewed the titles of all hits and the abstracts of all hits with relevant sounding titles and obtained the full text of all papers where the abstract indicated any likelihood that data relevant to the PICO question may be extractable. I reviewed the reference lists of all papers that included relevant data for further titles and I also searched medline for related articles for all the papers with relevant data and citing articles of the identified relevant Embase articles.

In medline

Search terms: resuscitation or cardiopulmonary resuscitation (limit to human, abstract, infant birth to 1 month) 5557 hits.

Search terms asphyxia neonatorum (limit to human, abstract, infant birth to 1 month). 2623 hits.

Search terms caesarean section and newborn (limit to human, abstract) 8534 hits

Search terms caesarean section and resuscitation (limit to human, abstract) 430 hits

Search terms caesarean section and intubation (limit to human, abstract, newborn infant) 177 hits

In Embase

Search terms caesarean section (incl all related terms) and newborn (including all related terms. Limit to human and abstract. 11917 hits

Search terms caesarean section (incl all related terms) and resuscitation (including all related terms). Limit to human and abstract 10382 hits. Limit to newborn 139 hits.

Search terms caesarean section (incl all related terms) and intubation (incl all related terms). Limit to human, abstract and newborn 229 hits.

Search term cardiopulmonary resuscitation, including all related terms (limit to human, abstract, newborn) 57 hits.

Search terms resuscitation including all related terms (limit to human, abstract, newborn). 131 hits.

Search terms asphyxia neonatorum, including all related terms (limit to human abstract, newborn). 25 hits.

5 papers were identified that included data that were relevant to the PICO question. 2 further papers were included for the worksheet because although they did not directly address the PICO question they included data that showed a very large fall over time in the proportion of infants who required intubation for all modes of delivery.

**State inclusion and exclusion criteria**

Inclusion – any human study providing a measure of the likelihood of requiring either mask ventilation or intubation at birth in a well-defined population of infants delivered by caesarean section under regional anaesthesia, with a comparison group of low risk unassisted vaginal births. Abstract available.

Exclusion - Single case reports, review articles, animal studies, studies in infants <34 weeks gestation.

**Number of articles/sources meeting criteria for further review:**

7
### Summary of evidence

#### Evidence Supporting Clinical Question

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A = Return of spontaneous circulation  
B = Survival of event  
C = Survival to hospital discharge  
D = Intact neurological survival  
E = Other endpoint  

*Italics = Animal studies*
### Evidence Neutral to Clinical question

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### Level of evidence

- **A** = Return of spontaneous circulation
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- **D** = Intact neurological survival
- **E** = Other endpoint
- **int** = Intubation

*Italics = Animal studies*

### Evidence Opposing Clinical Question

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### Level of evidence

- **A** = Return of spontaneous circulation
- **B** = Survival of event
- **C** = Survival to hospital discharge
- **D** = Intact neurological survival
- **E** = Other endpoint
- **int/mask** = Intubation/mask ventilation

*Italics = Animal studies*
REVIEWER'S FINAL COMMENTS AND ASSESSMENT OF BENEFIT / RISK:

This worksheet considers whether elective caesarean section under regional anaesthesia is associated with increased risk of the infant requiring mask ventilation or intubation at birth in comparison with unassisted vaginal delivery. The question is relevant because a substantial number of infants are now delivered by c-section under regional anaesthesia and in some centres this is deemed to indicate the need for a practitioner who is skilled in advanced resuscitation (i.e., someone who can intubate if required) to attend the delivery. The studies by Allwood 2003 f375 and Little 2007 156 are relevant because they show that in recent years, the likelihood of an infant requiring intubation at birth has been falling steadily for all forms of delivery. This means that historical estimates of risk are likely to overestimate risk relative to the present day. A lot of studies report the risk of low Apgar scores but most of these do not report rates of mask ventilation or intubation and were not included in this review. Five studies were included from which relevant data could be extracted (Annibale 1995 862, Atherton 2006 332, Gordon 2005 599, Jacob 1997 217, Parsons 1998 241). All reported the risk of requiring intubation in cases where there were not other identified risk factors before delivery and compared elective caesarean section under regional anaesthesia with unassisted vertex vaginal delivery. Three reported rates for the infant requiring mask ventilation (Annibale 1995 862, Atherton 2006 332, and Gordon 2005 599). All restricted their cases to term infants (> 37 weeks gestation) so the answer to this PICO question should not be extrapolated to infants 35-36+6 weeks gestation. However as the risks of other perinatal problems is increased with caesarean section before term, planned c-section in the absence of other identified risk factors should not take place before 37 weeks. Other problems related to neonatal adaptation that occur more frequently in infants delivered by elective caesarean section, such as transient tachypnoea of the newborn or other respiratory problems are beyond the scope of this worksheet which is solely concerned with requirement for positive pressure ventilation at birth.

Pooling the data from the 3 studies that reported rates for mask ventilation (Annibale 1995 862, Atherton 2006 332, Gordon 2005 599), 1831/5983 (3.39%) of infants delivered vaginally without assistance and 403/6368 (6.33%) of infants delivered by c-section under regional anaesthesia required mask ventilation at birth. Using the Centre for Evidence Based Medicine on-line statistical tool these numbers give a Chi-squared p-value of <0.001. The event rate difference for mask ventilation after c-section is 2.94%. The number needed to treat is 34 infants – one additional infant requiring mask ventilation at birth for every 34 caesarean sections (95% confidence interval 27-42).

Pooling the data from the 5 studies that reported rates for intubation (Annibale 1995 862, Atherton 2006 332, Gordon 2005 599, Jacob 1997 217, Parsons 1998 241) 173 of 86,996 infants delivered vaginally without assistance (0.2%), and 17 of 7748 infants delivered by c-section under regional anaesthesia (0.22%) were intubated at birth. Using the Centre for Evidence Based Medicine on-line statistical tool these numbers give a Chi-squared p-value of 0.799. The event rate difference for intubation after c-section is +0.02% with 95 percent confidence intervals minus 0.07% to +0.16%. The number needed to treat is 4866 infants.

Infants delivered by c-section under regional anaesthesia are slightly more likely to require mask ventilation at birth than low risk infants born by unassisted vaginal delivery. There is no statistically significant or clinically relevant increase in the risk of need for intubation at birth in infants without other identified risk factors delivered at term by c-section compared with low risk unassisted vaginal deliveries.

Acknowledgements:
Citation List


LOE 4. Quality good. Outcome: Intubation (Int). Direction of support neutral. Effect size n/a. Summary: Single centre study of 18000 births at all gestations 1993-7. Intubation fell from 2.4% to 1.2% during the study period. 1.2% for 34-37 weekers, 0.4% for 37+ weekers. Half way through the study there was a switch from bag and mask to t-piece ventilation and this was not associated with a significant alteration in the number of infants intubated. This study was included in the worksheet because, along with the study of Little, it shows that the number of infants considered to require intubation at birth is steadily decreasing over time. This may be attributable in part to greater consistency in training and guidelines for neonatal resuscitation. It means that estimates of intubation risk that come from older data might need to be viewed with caution.


LOE 4. Quality good. Outcome Intubation (int/mask) effect neutral. C/S under regional anaesthesia was not an important risk factor for needing intubation at birth. Summary: 2 centre study. Term infants. 10673 births 1983-92 with relevant data. Outcome of C section under regional anaesthesia without antenatally identified risk factors (331) versus vaginal birth in term singletons without prenatally identified complications (10871). Intubation in both groups was <1% (0/331 vs 12/10683). No infant delivered by elective section under regional anaesthesia required intubation. Mask ventilation was required by 91/10703 infants delivered vaginally and 5/326 infants delivered by c. section under regional anaesthesia.


LOE 4. Quality good. Outcome intubation (int/mask). Support neutral. Magnitude of support n/a. Summary: Hospital database of 44900 singleton term infants delivered vaginally (non instrumental) or by C/S in a single centre over 13 years. Amongst term singleton infants without fetal distress intubation was required in 50/21547 unassisted vaginal births and 9/3119 c/s under regional anaesthesia. Mask ventilation was required by 908/21547 and 242/3119 infants respectively.

LOE 3. Quality. Good. Direction of support neutral. Effect size n/a. Summary: Two centre case control study looking at need for resuscitation (bag and mask or more) after c/s in comparison with next term SVD. 2 year study period 93-95. Excluded cases with significant maternal or fetal problem known before delivery, incl msaf. 834 caesareans. Intubation data can be extracted for 291 elective repeat C/S under regional anaesthesia and none required intubation. None of their corresponding control infants who were term spontaneous undistressed births required intubation.


LOE 4. Quality good. Outcome intubation. Direction of support neutral magnitude of effect n/a. Summary: Large dataset reporting 221,000 singleton live births to nulliparous women in the North Thames Database of 15 hospitals 1988-2000. All gestations included. Intubated IPPV (after adjustment for birthweight fell from 0.51% to 0.07% from 1988 to 2000. There has been a significant reduction in both intubated and non intubated IPPV over time affecting all birth categories that is not attributable to reduced general anaesthesia or increased C/S.


LOE 4. Quality good. outcome intubation. Direction of support neutral. Effect size n/a. Summary: 64739 term singleton infants delivered in Tasmania in 1980-89. intubation was required by 99/32742 term SVDs and by 6/1089 repeat C/S under epidural. 2.7% of primary C/S under epidural And 6.3% of primary C/S under Ga. The study looked at low apgars rather than use of bag and mask.