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ORIGINAL RESEARCH

Prolonged rupture of membranes in term infants: Should all babies be screened?

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Background: Prolonged rupture of fetal membranes (>24 hours) is a major risk factor for early onset sepsis in neonates. In Northern Ireland there is no consistency on the management of this problem and individual clinical guidelines vary widely between neonatal departments. At present in Craigavon Area Hospital all term babies born with prolonged rupture of fetal membranes have screening blood analysis performed, regardless of what is found on risk factor assessment.

Setting: The neonatal department of Craigavon Area Hospital a district general hospital in Northern Ireland.

Objectives: To determine if the current guidelines on the management of prolonged rupture of fetal membranes in term infants are being followed. The audit will also try to determine if the decision on whether to perform screening blood analysis was left up to the individual doctor's clinical judgment, would they make a safe decision.

Design: A prospective audit was carried out over a three-month period between October 2008 and January 2009. Term infants born during this period where fetal membranes had ruptured for more than 24 hours prior to delivery were included in the audit.

Results: At present there is 100% compliance with the current hospital guidelines and there is evidence that if the decision of whether to perform screening blood analysis is left up to the individual doctor's clinical judgment, they will make a sensible decision based on the infants risk factor assessment. None of the infants that the doctor decided they wouldn't screen came to any harm.

Conclusion: Combining the results of the audit and the availability of nationally recognized guidelines it was decided to adopt the National Institute for Health and Clinical Excellence (NICE) guidelines in Craigavon Hospital. To help facilitate this change a neonatal early warning score (NEWS) observation chart has been developed to record the observations recommended by NICE. As there has been a major change in the management of this condition it is planned to re-audit in the near future to ensure that adopting this less invasive strategy does not result in any increase in adverse neonatal outcomes.

Keywords: prolonged rupture of fetal membranes, neonatal, sepsis, audit

Introduction

The prolonged rupture of fetal membranes (PROM) is a major risk factor for the early onset sepsis in neonates. Its presence increases the risk of serious neonatal infection to 1%, compared to 0.5% for women with intact membranes.[1] The mortality rate for neonatal sepsis is high, with ranges quoted between 5% and 50%.[2] For this reason the current policy in Craigavon Area Hospital for managing babies born where membranes ruptured more than 24 hours prior to delivery is aggressive.

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Craigavon Area Hospital is a busy district general hospital in Northern Ireland with 3,900 deliveries per year. The current policy for the management of PROM was developed in 2006. It recommends that all infants where the fetal membranes have ruptured for a period greater than 24 hours prior to delivery should have a full blood picture, C-reactive protein and blood cultures performed shortly after birth. If the baby is born at term (≥37 weeks) and is clinically well, antibiotics are not given initially. If when the inflammatory markers come back there is any concern, the baby should be treated with intravenous antibiotics while the blood cultures are pending. If at any stage the baby displays signs of sepsis the infant must be started on antibiotics immediately and transferred to the neonatal unit.

In Northern Ireland there is no consistency on the management of this problem and the individual clinical guidelines vary widely between different neonatal departments. Many of the guidelines are not as strict as Craigavon Hospital's and allow the individual doctor to carry out a risk assessment on the baby, and based on this, make a clinical judgment as to whether they are going to perform screening blood analysis or start antibiotics. Also the National Institute for Health and Clinical Excellence (NICE) has published guidelines on intrapartum care, which does not recommend the routine use of screening blood analysis in term infants with PROM.

Objectives

1. To determine if the current guidelines on the management of PROM in term infants are being followed in Craigavon Hospital.
2. To determine if the decision on whether to perform screening blood analysis was left up to the individual doctor's clinical judgment, would they make a safe decision.

Standards

1. Term babies born with PROM for a period greater than 24 hours should have screening blood analysis performed (full blood picture, C-reactive protein and blood culture) – 100%
2. If the baby displays signs of sepsis the infant should be started on antibiotics and transferred to the neonatal unit – 100%
3. If the decision was made by the doctor that they would prefer to rely on their clinical judgment and would not have screened the baby if it was not the policy to do so, the infant should not develop sepsis – 100%

The first two standards are based on compliance with the current hospital guidelines and the third standard is based on patient safety.

Design

A prospective audit was carried out over a three month period between October 2008 and January 2009. Term babies born with PROM for a period greater than 24 hours were identified in the delivery suite and an audit questionnaire placed in their notes. When the doctor was called to review the baby they were asked to fill in the first section of the audit questionnaire, after having assessed the baby.

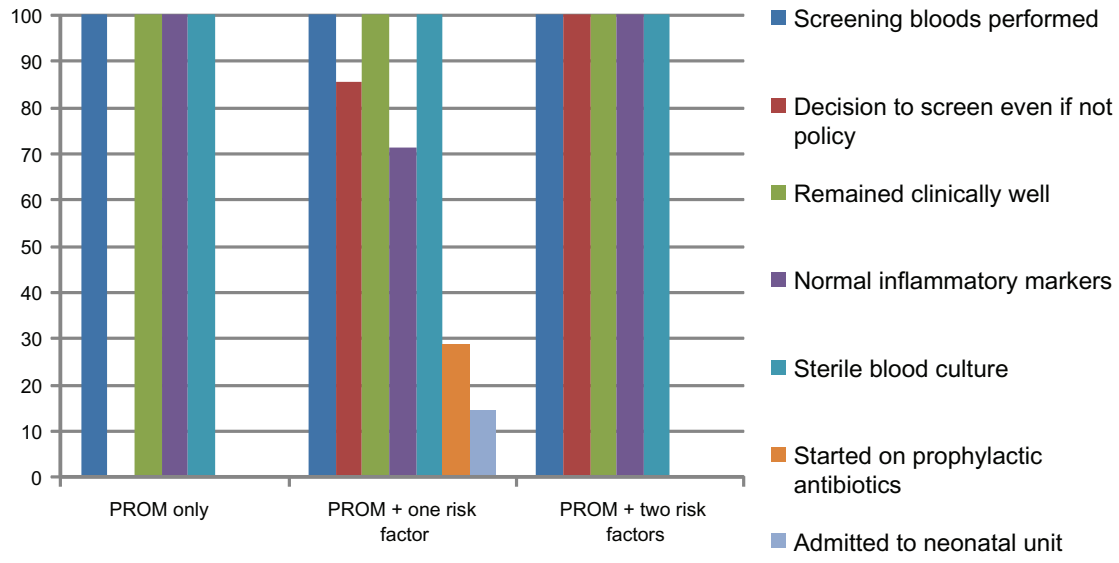

Figure 1 Summary of results based on the number of risk factors.
Abbreviation: PROM, prolonged rupture of fetal membranes.

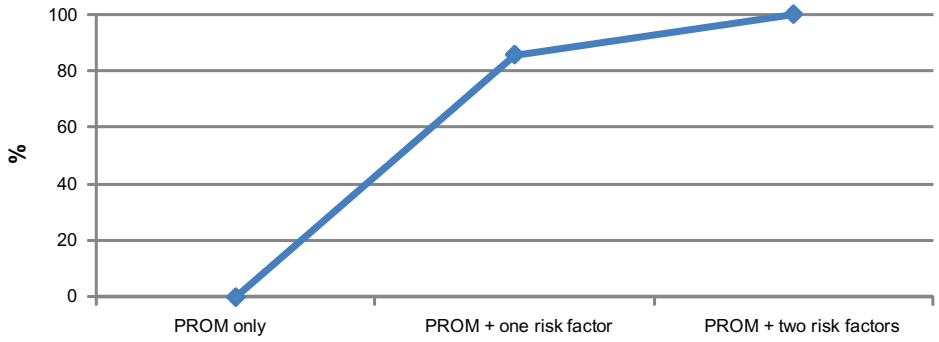

Figure 2 Precentage of babies who would be screened if it were not the policy to do so based on the number of risk factors.
Abbreviation: PROM, prolonged rupture of fetal membranes.

The first section of the questionnaire included a risk factor assessment where the initial doctor should document the presence or absence of the following risk factors for neonatal sepsis.

- PROM for a period greater than 24 hours
- No maternal antibiotics or maternal antibiotics less than 4 hours prior to delivery
- Maternal temp greater than 38 °C
- Raised inflammatory markers in mother
- Maternal carriage of *Group B Streptococcus* (GBS)
- Previous infant with GBS
- Positive vaginal swab
- Foul smelling liquor (indicated possible chorioamnionitis)
- Abnormal observations in the baby
- Baby clinically unwell

After documenting the risk factors the doctor was asked to make a clinical judgment by answering the following question "If it were not the policy to perform screening blood analysis on this baby, would you have performed them anyway?"

On discharge, all babies charts were examined by one reviewer, looking firstly at whether the current guidelines had been followed, by examining the notes to ensure that all babies had a full blood picture, C-reactive protein and blood culture performed, and that if any babies had displayed signs of sepsis that the infant was started on antibiotics and transferred to the neonatal unit.

Secondly, all charts were reviewed to look for evidence of the doctors clinical judgment as to whether they would have screened the baby if it were not the policy to do so was a good decision or not. Data was collected on the infants inflammatory markers, blood culture results, need for neonatal unit admission or if the infant became clinically unwell at any stage.

Results

Over the three-month period there was a total of 16 audit questionnaires completed. There was 100% compliance with the local hospital guidelines, as all babies had a full blood picture, C-reactive protein and blood culture preformed. None of the babies became unwell or showed any signs of sepsis during their admission so there was no requirement for them to be treated with antibiotics or admitted to the neonatal unit.

Out of the sixteen babies eight had PROM as their only risk factor for sepsis, seven had PROM plus one other risk factor and one baby had PROM plus two other risk factors.

No other risk factor – 8/16 babies

In eight of the cases the only risk factor for sepsis identified was PROM. In all cases (100%) the doctor called to review the baby would not have performed screening blood analysis on the baby if it were not the policy to do so. All of the babies remained clinically well, had normal inflammatory markers, sterile blood cultures, were not started on antibiotics and did not require admission to the neonatal unit.

One other risk factor – 7/16 babies

PROM and inadequate maternal antibiotics

Three babies had PROM associated with inadequate maternal antibiotics (no antibiotics or antibiotics <4 hours prior to delivery). The doctor called to review these babies would have performed screening blood analysis in two out of three cases if it were not the policy to do so. Two of the babies remained clinically well, had normal inflammatory markers, sterile blood cultures, were not started on antibiotics and did not require admission to the neonatal unit.

One baby, who would have been screened if it were not the policy to have done so, was noted to have low white cells of 3.29×10^9/L and a normal C-reactive protein of <0.88 mg/L. In view of this the baby was treated with 48 hours of intravenous benzylpenicillin and gentamicin,

while blood cultures were pending. The blood cultures were sterile and the baby remained clinically well. This baby was however admitted to the neonatal unit for an unrelated reason as they required treatment for a high packed cell volume.

PROM and maternal *Group B streptococcus* (GBS) colonization

There were three babies with both PROM and maternal GBS colonization. Despite all the mothers having received adequate antibiotics the doctors called to review the babies would have performed screening blood analysis in all three cases (100%) even if it were not the policy to have done so.

The first baby was started on intravenous benzylpenicillin and gentamicin prior to screening blood analysis results being available. This baby remained clinically well, had normal inflammatory markers, sterile blood cultures and did not require admission to the neonatal unit.

The second baby had a raised white cell count of 31.2×10^9/L and a normal C-reactive protein of < 0.88 mg/L. Despite this the baby remained clinically well, had normal inflammatory markers, sterile blood cultures, was not started on antibiotics and did not require admission to the neonatal unit.

The third baby remained clinically well, had normal inflammatory markers, sterile blood cultures, was not started on antibiotics and did not require admission to the neonatal unit.

PROM and maternal pyrexia

There was one baby with both PROM and maternal pyrexia greater than 38 °C. Despite the mother having received adequate antibiotics the doctor called to review the baby would have performed screening blood analysis, even if it were not the policy to have done so. This baby remained clinically well, had normal inflammatory markers, sterile blood cultures, was not started on antibiotics and did not require admission to the neonatal unit.

Two other risk factors – 1/16 babies

There was one baby who as well as PROM had inadequate maternal antibiotics and a documented temperature of 37.6 °C. This baby remained clinically well, had normal inflammatory markers, sterile blood cultures, was not started on antibiotics and did not require admission to the neonatal unit.

Discussion

The results for the audit are encouraging with the current guideline being followed in 100% of cases as all sixteen babies had screening blood analysis performed. None of the babies became unwell or showed any signs of sepsis during their admission, so there was no requirement for them to be treated with antibiotics or admitted to the neonatal unit. This meant compliance with the second standard could not be assessed.

When looking at the doctors decision as to whether they would have performed screening blood analysis, if it were not the policy have done so, a trend can be seen related to the number of risk factors for sepsis that are present (Figure 2). In cases where the baby had no other risk factors for sepsis (apart from PROM) the doctors called to review the babies would not have screened any of the babies. This can be compared to cases of PROM plus one other risk factor and cases of PROM plus two other risk factors where screening blood analysis would have been performed in 85.7% and 100% of cases respectively.

This trend demonstrates that the doctors involved are using the number of risk factors present to help them make an assessment about a baby's risk of sepsis. This seems to be a logical conclusion and in fact many neonatal departments have a risk factor assessment incorporated into their PROM guideline to help doctors decide which babies to screen and which babies to treat.

Another point demonstrated by the audit results is that doctors feel the current policy of performing screening blood analysis in all babies is unnecessary. This is demonstrated by the fact that in all cases where PROM was associated with no other risk factors none of the doctors called to review the babies would have performed a screening blood analysis, if it were not the policy to have done so. Although the numbers in the audit were too small to draw any statistically significant conclusions, the doctors decision not to perform a screening blood analysis would have been a safe decision for the babies involved, as they all remained clinically well and had normal inflammatory markers and sterile blood cultures.

Some of the risk factors for sepsis are generally felt to be more significant than others. In particular the combination of PROM and GBS would be considered by many pediatricians to significantly increase the baby's risk of sepsis. One study which looked at this showed that mothers testing positive for GBS combined with PROM had a significantly increased the risk of sepsis compared to unknown or negative GBS status odds ratio (OR) 0.308 (95% confidence interval [CI]: 2.02 to 4.68).[3] This dangerous combination was recognized by the doctors in the audit and they would have performed screening blood analysis in 100% of these babies even if it was not the policy to have done so. In fact in one case the baby was

screened and commenced on prophylactic antibiotics prior to the inflammatory markers coming back.

In general throughout the audit all the doctor' thinking seemed to be similar, apart from in one area where the practice varied significantly. This was when dealing with abnormal inflammatory markers and it occurred on two occasions throughout the audit. In the first example a baby with PROM and inadequate maternal antibiotics was screened and noted to have a low white cell count of 3.29×10^9/L. The doctor involved adopted a safe approach and started the baby on antibiotics while the cultures were pending. This contrasts with the second example where a baby with PROM and maternal GBS was noted to have a slightly raised white cell count at 31.2×10^9/L. The doctor involved was reassured by a normal C-reactive protein and did not start any prophylactic antibiotics despite, as it has already been mentioned, the combination of PROM and GBS putting the infant at significantly increased risk of sepsis.

This highlights a crucial issue about using inflammatory markers such as the C-reactive protein as a marker for sepsis. The C-reactive protein is an acute phase protein that begins to rise within 4–6 hours of the onset of infection, should be abnormal within 24 hours of infection and peaks within 2–3 days.[2] For this reason if done too early in an episode of sepsis it will be normal. It is also worth noting that the C-reactive protein is elevated at some point in 50%–90% of infants with systemic bacterial infection.[4] This means that in up to 50% of cases of systemic bacterial infection the C-reactive protein is normal. For these reasons it should be remembered that a normal C-reactive protein result does not exclude sepsis. A large cohort study with 175 babies with PROM concluded that a full blood picture has a sensitivity of 86% and a specificity of 66% for picking up neonatal sepsis.[5]

The results of the audit although encouraging (as there is 100% compliance with the current guidelines) raised the issue that most of the doctors felt that the guidelines, where all babies should be screened regardless of risk factors, may be over aggressive and in fact not in the babies best interest. It must be remembered that performing blood tests on a newborn baby causes significant pain and distress to both the baby and the parents. Also if the blood cultures are contaminated by skin flora, which is not an uncommon occurrence despite best efforts, this will expose the neonate to unnecessary antibiotics. As the antibiotics administered often include gentamicin this puts the infant at risk of vestibular and auditory damage, nephrotoxicity and antibiotic associated colitis.[6] Another point of consideration is that none of the infants involved in the audit would have come to any harm if they did not have screening tests performed, despite some of the babies having three risk factors for neonatal sepsis.

The results of the audit prompted a literature review. After the hospital guidelines were written in 2006, the National Institute for Health and Clinical Excellence (NICE) published a guideline on intrapartum care, which included a section on managing PROM in term infants. When this guideline was compared with the current hospital policy significant changes in the recommended management was noted.

The NICE guidelines recommended that asymptomatic term babies born to women with pre-labor rupture of the fetal membranes, (more than 24 hours before delivery) should not have routine blood tests performed, but should be closely monitored during the first 12 hours of life.

NICE made a clear differentiation between these asymptomatic babies and babies with symptoms of possible sepsis, or babies born to a woman who had evidence of chorioamnionitis. In the latter cases NICE recommended immediate referral to a neonatal care specialist.

Another change from the current hospital policy was noted in the obstetric management of PROM. NICE no longer recommended the routine administration of prophylactic antibiotics to women with PROM. In fact the obstetric department in Craigavon Hospital has started to implement the NICE guidelines during the time the audit was being carried out. This was useful in explaining why some of the mothers, according to the current hospital policy, had not received adequate antenatal antibiotics.

Conclusion

At present there is 100% compliance with the current hospital guideline and there is evidence to suggest that if the decision of whether to perform screening blood analysis is left up to the individual doctor's clinical judgment, they will make a sensible decision based on the infant's risk factor assessment. None of the infants that the doctor decided they would not screen, if it were not the policy to have done so, would have come to any harm if they hadn't had screening blood analysis performed.

Combining the results of the audit and the availability of nationally recognized guidelines it was decided to adopt the NICE guidelines in Craigavon Hospital.

The fact that the NICE guidelines use abnormal observation rather that screening blood analysis to detect evidence of sepsis in asymptomatic infants has resulted in the development of a neonatal early warning score (NEWS) observation chart for use in Craigavon Hospital. It is planned to use this chart to record observations in all infants with PROM at

times directed by the NICE guidelines. It is felt this tool will prompt earlier action on abnormal observations in infants with sepsis.

As there has been a major change in the management of this condition it is planned to re-audit in the near future to ensure that adopting this less invasive strategy does not result in any increase in adverse neonatal outcomes.

Disclosures

The authors report no conflicts of interest with this work.

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