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ORIGINAL ARTICLE

Projected improvement in the fast microbiological analysis of neonatal blood samples

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Blood culture;
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Microbiological diagnostics;
Neonatal sepsis;
Sensoring of microbial volatile compounds;
Rapid microbial detection;
Point of care microbiology

Abstract *Purpose:* To investigate whether Portable Microbe Enrichment Unit (PMEU) Scentrion® (Finnoflag Oy, Kuopio and Siilinjärvi, Finland) can provide a faster, more effective and accurate way of diagnosing sepsis and identifying pathogenic bacteria compared to the standard method in Kuopio University Hospital.
Design and samples: Blood samples from 56 diseased neonates were collected and enriched by the PMEU Scentrion® and standard method. After enrichment all detected bacteria were cultured by Eastern Finland Laboratory Centre Joint Authority Enterprise (ISLAB).
Main outcome and results: Results were similar for both methods. Bacterial growth was indicated in 37 samples. Bacterial blood culture was positive in only six blood samples. 26 patients had a clinical diagnosis of sepsis. 20 patients were treated empirically because the bacterium could not be identified.
Conclusions: PMEU Scentrion® proved out to be capable of providing early signs of bacterial growth in blood samples with increased efficiency. Development of the PMEU software and use of more specific culture broth could offer means for increased speed, specificity and sensitivity for the analysis of neonatal sepsis.

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These further improvements could provide tools for verifying more sepsis causing pathogens by rapid methodology.

Introduction

Newborn babies are in greater risk of sepsis due to their immature immune system, possible severe conditions or disorders, central venous catheters or other alien objects and surgery. Intensive care and a prolonged hospital stay are also risk factors.

The sepsis of a newborn can be divided into two groups: early- and late-onset sepsis. In early-onset sepsis the symptoms start within 72 h after birth. Rupture of membranes over 18 h before delivery, maternal infection (most commonly chronic group B *Streptococcus*, GBS), gestational age, vaginal mode of delivery, very low birth weight, lack of antenatal care and amnionitis are risk factors. Additionally, the immaturity of the mucous membranes of the intestines of preterm neonates predisposes them to gastrointestinal infections. Parenteral feeding increases this risk and slows down the mucous layer development (Stoll et al., 1996a; Klinger et al., 2009).

Late-onset sepsis means infection that starts after 72 h of age. It is usually related to treatment: central catheters, mechanical ventilation, surgical operations and parenteral nutrition predispose to infections. If the infant is full-term, the symptoms often occur after discharging and there are no specific risk factors (Stoll et al., 1996b).

The symptoms of sepsis among neonates are obscure: hypo- or hyperthermia, feeding difficulties, crying, agitation, pallid behaviour and abnormal breathing can be signs of infection. The symptoms may vary according to the origin of the infection (Fellman and Luukkainen, 2010). Diagnosis is based on the symptoms and blood culture. Problem is that the volume of the blood culture sample of a neonate is small, 0.5—1.0 ml, and the amount of the microbes is low in both the blood and the sample. Also the possible antibiotic treatment given to mother before delivery can prevent microbes from growing in the blood culture. It is common that blood samples stay negative although sepsis is clinically obvious (Kurlat et al., 1989; Fischer, 2005).

The diagnosis and identification of the microbial pathogens is crucial for effective treatment. The method has to be fast and precise. The faster the antibiotic treatment starts the better is the prognosis. Ineffective medication can lead to resistance development in the bacterial strains, injury or even death. It also causes extra costs for the society and the hospital. The Portable Microbe Enrichment Unit (PMEU; Finnoflag Oy, Kuopio and Siilinjärvi, Finland) method offers means for point of care diagnostics in neonatal wards.

This study was undertaken to develop more effective ways of diagnosing sepsis in neonates. 56 neonates cared for at the Neonatal Intensive Care Unit (NICU) of Kuopio University Hospital (KUH) took part in this study in the year 2010.

Methods

Blood samples

Neonates born in the KUH with risk factors or symptoms indicating to sepsis were treated in the NICU. Bacteriological blood specimens were collected from 56 neonatal patients during the year 2010. Two blood culture samples were drawn from one peripheral artery or vein right after the puncture: the other for the enrichment system of the study and the other for the system of the hospital's official laboratory, Eastern Finland Laboratory Centre Joint Authority Enterprise (ISLAB). The volume of both samples was 0.5—1.0 ml. However, if the collected blood volume was less than 1.0 ml, whole sample was processed in the ISLAB. If microbial growth was detected during the enrichment phase, the samples were cultured in the ISLAB, on blood- and chocolate plates.

The enrichment method of bioMérieux

The ISLAB uses bioMérieux —hardware (bioMérieux Corporate, Paris, France) as a standard method for enrichment of bacteria of blood culture samples. BacT/ALERT® PF (bioMérieux) blood culture bottles, that are meant for aerobic bacteria, are used in the standard practice because the anaerobic agents are regarded as rare causes of neonatal sepsis. Bottles contain culture broth and substances that deter antibiotics from inhibiting the bacterial growth. Blood samples are incubated in the BacT/ALERT —hardware in 35 °C. The bacterial growth is detected by the change of the