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Case study—faster bilirubin results allow rapid patient treatment at St. Michael’s Neonatal Intensive Care Unit

Neonatal bilirubin (n-Bili)

Staff in the neonatal ICU at St. Michael’s Hospital, Bristol, are now able to obtain bilirubin test results in 60 seconds using the RAPIDLab® 1265 Blood Gas analyzer from Siemens Healthcare Diagnostics, enabling appropriate care at the earliest opportunity for critically ill babies.



Bilirubin

When red blood cells degrade, the hemoglobin breaks down to form unconjugated bilirubin. This is taken up by the liver where it binds to sugars to make water-soluble, conjugated bilirubin, which is excreted in bile. Each gram of hemoglobin breaks down to yield 600 μmol s of bilirubin.

An increase in bilirubin in the blood presents clinically as jaundice and may be caused by over production of bilirubin (increased hemolysis), a decrease in the liver’s capacity to remove bilirubin, or blocked bile ducts.

Increased blood bilirubin in newborns

Jaundice is commonly seen in newborns in the first 3 days after birth. This is often due to physiologic jaundice and resolves in a few days.

However, in some instances, breakdown of the baby’s red blood cells may be due to other factors, such as:

- incompatibilities between the baby’s blood and the mother’s blood (hemolytic disease of the newborn)
- bruising at birth
- cephalohematoma
- dehydration due to inadequate fluid intake
- infection
- polycythemia
- breast feeding
- use of certain drugs at delivery

Furthermore, a number of conditions can cause excessive breakdown of erythrocytes in the fetus and neonate and may present as early jaundice, i.e., within the first 24 hours. These include several inherited defects, such as spherocytosis, pyruvate kinase deficiency, and glucose-6-phosphate dehydrogenase deficiency.

Excessive bilirubin in the blood may lead to damage of the developing brain cells (kernicterus), which may cause seizures, lethargy, progressive nerve deafness, and rarely, athetoid cerebral palsy.

Point of Care (POC) testing for bilirubin

The bilirubin test is performed frequently in the neonatal ICU at St. Michael’s Hospital, Bristol (part of the United Bristol Healthcare NHS Trust). Neonatal technician Bridget Robbins, explains, “We need to monitor bilirubin closely in order to prevent the serious consequences of kernicterus. If levels greater than 300 $\mu\text{mol/L}$ are seen in babies over 3 days old, we would initiate phototherapy. If the levels are extremely high, then double phototherapy or an exchange blood transfusion may be required.”

“It is important to obtain results quickly,” Robbins continues, “since bilirubin levels can rise very rapidly in neonates. In the past we had to send the samples to the laboratory for analysis, which could take up to 4 hours to receive a result, but we now use the RAPIDLab 1265 assay, which can be performed at the point of care, in the neonatal ICU. We are now able to obtain results in just 60 seconds, which means that we can implement treatment much more quickly if it is required.”

Proven performance

An evaluation was made, comparing the RAPIDLab method with the laboratory method, to ensure that the faster results did not compromise on quality.

Laboratory method: **Total Bilirubin** (O'Leary) for the quantitative determination of Total Bilirubin in serum and plasma on Olympus automated analyzers.

"We analyzed 117 samples from the neonatal ICU, using both the laboratory method and the RAPIDLab method, in order to evaluate the performance of the point-of-care assay," explains Principal Clinical Scientist Janet Stone. "The laboratory method is a colorimetric assay, based on the oxidation of bilirubin to biliverdin in the presence of ferricyanide ions, which involves measuring absorbance at 450-470 nm before and after the reaction. It generally takes about 30 minutes to perform on arrival of the sample in the laboratory."

A linear regression analysis of the results (Figure 1) demonstrated that there was good correlation (minimal scatter) between the RAPIDLab method and the laboratory reference method for the measurement of bilirubin levels in neonatal blood samples.

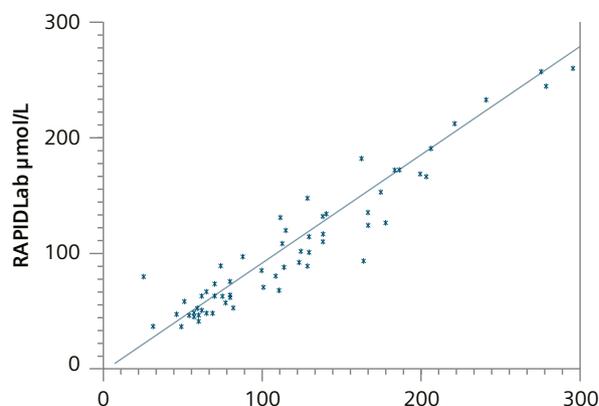
"There were no samples in the group with the time difference less than 30 minutes where the difference between the results from the blood gas analyzer and the laboratory assay would have affected the clinical decision regarding treatment," Stone remarks.

"We found the RAPIDLab method to be comparable with the laboratory method. In conclusion, we determined that the RAPIDLab method is suitable for performing pediatric bilirubin measurements, since the turnaround time is much faster and the results are reliable."

"The few instances where the results were not compatible may have been due to the presence of conjugated bilirubin," Stone adds, "and so I would recommend a laboratory measurement if a conjugated jaundice is suspected."

"As a result of our evaluation," concludes Robbins, "we are happy to adopt the Siemens RAPIDLab method for routine bilirubin testing in the neonatal ICU."

Figure 1. A comparison of the RAPIDLab bilirubin assay and the laboratory reference method



Lab Method µmol/L

Equation:

$\text{RAPIDLab} = -4.3 + 0.96 \times \text{Lab Method}$,

RMSE = 19.1, $r^2 = 0.91$

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