

# Practical Significance and Economic Efficiency of Transcutaneous Bilirubinometry

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## Clinical Note

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## Abstract

Recently, a number of research papers have been published in the medical literature, demonstrating the effectiveness of the transcutaneous bilirubinometry method in both full - term and premature infants. This technique is widely implemented in most hospitals around the world and is a screening for pathological hyperbilirubinemia. The use of the device for transcutaneous bilirubinometry can significantly reduce the frequency of invasive studies of the level of bilirubinemia. The purpose of this analysis was to compare transcutaneous and invasive methods for determining bilirubin in the group of full-term and premature infants, as well as to determine the cost-effectiveness of this technique on the example of the JM-105. The device Jaundice Meter Model JM-105 (Draeger Medical Systems, Germany) uses two wavelengths and a double optical path system. The result of each definition is calculated as the average of the three dimensions. Resource charged battery 250 measurements. Lamp life 150000 measurements. No consumables. The following results were obtained in full-term children: in the range of bilirubin concentrations from 100 to 255  $\mu\text{mol/l}$  between the results of serum bilirubin and transcutaneous measurement device JM-105" found a very close correlation -  $r=0.97$ ,  $p<0.05$ . As a result of examination of premature newborns: at the level of bilirubinemia from 50 to 270  $\mu\text{mol/l}$ , the correlation between the invasive method of determining serum bilirubin and transcutaneous bilirubinometry JM-105 ( $r=0.95$ ). With an average cost of the device for transcutaneous bilirubinometry JM-105 about 8000 USD, which is the equivalent of about 8000 blood tests for bilirubin, taking into account the fact that this technique does not require additional consumables and significant investments for the entire period of the device, the use of this technique is economically feasible.

**Keywords:** Screening; Transcutaneous bilirubin determination; Jaundice; Premature infants; Infants

**Abbreviations:** TcB: Transcutaneous Determination of Bilirubin; TBS: Total Serum Bilirubin; TKB: Total Bilirubin Capillary Blood; GA: Gestational Age.

### Purpose of Research

Was to compare percutaneous and invasive methods of bilirubin determination in full-term groups (37-40 weeks of gestation) and premature infants with gestational age (28-34 weeks), as well as to determine the cost-effectiveness of this technique on the example of JM-105 [1].

### Methods

The study included 120 newborns with a gestation period of 37-40 weeks [2,3], with birth weight from 2500 to 4400 g and 44 premature infants with gestational age from 28 to 34 weeks, with birth weight in the range from 980 to 2720 grams[4]. Infants with documented cases of ABO(blood group system) or rhesus factor incompatibility, congenital malformations, hemoglobinopathy, and signs of liver damage were excluded from the study. In newborns aged 2 to 14 days of life, transcutaneous bilirubinometry was carried out by Drager JM-105 (produced by Drager Medical GmbH, Germany) [1]. In parallel, venous blood was taken for examination by liquid chromatography apparatus Dimension Rxl max (Siemens healthcare diagnostics, USA) in the laboratory. The transcutaneous measurement of bilirubin in the area of the forehead and chest of a premature newborn, covered from direct sunlight in the hair-free zone, and in the absence of hemorrhages, nevi or other skin abnormalities was carried out in the interval  $\pm$  30 minutes from the moment of determination of the total serum bilirubin (TBS). The use of transcutaneous bilirubinometer was carried out in accordance with the manufacturer's instructions [1].

All measurements in premature newborns were performed in the morning in natural light on the skin, forehead and chest. Bilirubin was measured again in children 24-72 hours after the primary measurement, depending on the dynamics of jaundice [2-4].

A total of 102 full-term infants underwent 281 parallel determination of bilirubin concentration by invasive and non-invasive methods, 44 premature infants underwent 70 parallel determination of bilirubin concentration by invasive and non-invasive methods. The level of bilirubinemia above 270  $\mu\text{mol/l}$  was excluded from the study, as the sensitivity of the transcutaneous technique

at such values decreased sharply. The calculation of the cost of performing one determination of blood bilirubin in the laboratory (excluding depreciation of equipment and the cost of electricity). To assess the economic efficiency of transcutaneous bilirubinometry, the JM-105 device is taken as an example. Statistical processing of the results was carried out using the application program Statistica (version 10.0).

### Results

As a result of the examination of full-term and premature newborns, during the statistical analysis with the calculation of the pair correlation coefficient ( $r$ ), the following results were obtained : in full-term newborns at the level of bilirubinemia from 100 to 255  $\mu\text{mol/l}$ , a very high degree of correlation was observed between the indicators of total bilirubin capillary blood (TKB) measured by the traditional method and the indicators of transcutaneous determination of bilirubin (TcB) measured by the device "JM-105" ( $r=0.97$ ,  $p<0.05$ ). In premature newborns: the level of bilirubinemia from 50 to 270  $\mu\text{mol/l}$  correlation between invasive method of determining TBS analyzer Dimension Rxl max and TcB on the forehead JM-105 ( $r=0.94$ ), TBS and TcB on the chest JM-105 ( $r=0.95$ ). The analysis of the cost of one blood test for bilirubin, taking into account the reagent and consumables, in a particular hospital. The average cost of one blood test is 1 USD. With an average cost of the device for transcutaneous bilirubinometry JM-105 about 8000 USD, which is the equivalent of about 8000 blood tests for bilirubin, taking into account the fact that this technique does not require additional consumables and significant investments for the entire period of the device, the use of this technique is economically feasible[5-8].

### Conclusion

When screening for bilirubinemia in premature infants, the JM-105 demonstrated good efficacy in comparison with invasive methods for determining bilirubinemia. This technique can be used in routine practice of management of full-term and premature infants with hyperbilirubinemia [9]. Routine use of transcutaneous bilirubinometry not only reduces the frequency of invasive intervention in the newborn, but also will significantly reduce the cost of laboratory diagnosis of bilirubinemia in the hospital [10,11].

### Conflict of Interest

The authors of the study declare that there is no conflict of financial interests in connection with the

preparation and conduct of this study, as well as the lack of any financial support for research.

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