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Implementation of Congenital Heart Diseases Screening at the Bihac Cantonal Hospital

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ABSTRACT

Introduction: Congenital heart defects (CHD) were the most common birth defects, and the most common cause of death in infants with congenital anomalies in developed countries. Early detection of these anomalies would greatly enhance the effect of therapeutic procedures and the final outcome. Lately, pulse oximetry (PO) is used for the purpose of screening the cyanotic congenital heart defects. PO in combination with the clinical examination has greater diagnostic sensitivity in detection of CHD. **Objective:** Application of PO screening in combination with a novel clinical examination methodology of cardiovascular system in neonate towards earlier detection of CHD. **Patients and methods:** Study included newborn children in Bihac Cantonal Hospital in the year 2012. The sample included 1,865 children. A total of 29 children with congenital heart disease was diagnosed during the neonatal period. **Conclusion:** Modern algorithm for early detection can significantly improve the diagnosis of congenital heart anomalies. Early detection allows optimal care for these children. This concept is simple, inexpensive and reproducible in most maternity wards.

Keywords: newborn, congenital heart defects, pulse oximetry.

1. INTRODUCTION

Congenital heart defects (CHD) were the most common birth defects, and the most common cause of death in infants with congenital anomalies in developed countries (1,2). Some heart anomalies (primarily cyanotic ones) require optimal care in the first week of life. Early detection of these anomalies would greatly enhance the effect of therapeutic procedures and the final outcome (3). Current methods of screening including ultrasonography in the middle trimester or postnatal examination of newborn, yield a low detection of CHD, and a significant number of children are discharged from the maternity ward with undiagnosed congenital heart disease (4-7). Delayed diagnosis of critical congenital heart defects is unfortunately all too common, with up to 25% of infants with these defects being missed in newborns when identification is based on clinical symptoms or signs of heart disease even in settings with routine prenatal sonograms (8). Mild hypoxemia is a mandatory companion of cyanotic CHD (9) and can be used for the purpose of screening. Each type of CHD affects cardiopulmonary circulation differently, and pulse oximetry is a good screening tool to detect lesions that cause hypoxemia in the first few days of life (10). Screening PO can significantly reduce diagnostic hole in the detection of cyanotic CHD, and the percentage of false positive results which would require additional diagnostic, often unnecessary tests, prove to be small (11). PO in combination with the clinical examination has greater diagnostic sensitivity in the detection of CHD (12).

2. OBJECTIVES

- Application of protocol for measurement of arterial oxygen saturation with functional type of transcutaneous pulse oxymeters.
- Application of new review methodology of the cardiovascular system of neonate.

3. PATIENTS AND METHODS

The survey was conducted in the maternity ward and the Department of Neonatology at the Cantonal Hospital in Bihac, in the period from 01 January to 31 December 2012. There were 1865 newborn babies. The study excluded 5 children for violating protocol. The sample included 1,860 children, of which 115 premature babies and 1745 term babies. Each child was measured

transcutaneous oxygen saturation by pulse oxymeters at second day of life, except for vulnerable children, where monitoring of vital functions was carried out continuously. The measurement was carried out on the right hand and on the right or the left leg, by trained medical staff (nurses, midwives). Training is simple and involves training nurses to conduct testing while child is calm and not experiencing lowered temperature. Lower saturation can be temporary if the child is chilled, crying or during feeding. We considered the longest, stable reading value of oxygen saturation. Pulse oximetry was performed by functional type of pulse oximeter (BT 700), with sensors for infants. The saturation result of 95% or higher at any measuring point or the difference between the right arm and leg of 3% or less, is considered as normal finding. Otherwise, the measurement was repeated two more times at intervals of one hour. If after repeatition, saturation remained below 95% at any measuring point, or the difference between the measured saturation at two sites is higher than 3%, screening was seen as positive and the child was a candidate for a cardiology consultation and ultrasound of the heart (Figure 1). In addition to testing PO, a diagnosis of congenital heart anomalies requires an essential clinical examination. The clinical examination involves the evaluation of skin color of the child (acrocyanosis of newborn is considered normal), assessing respiratory status, the value of the pulse, auscultatory finding on heart, palpation of peripheral pulses.

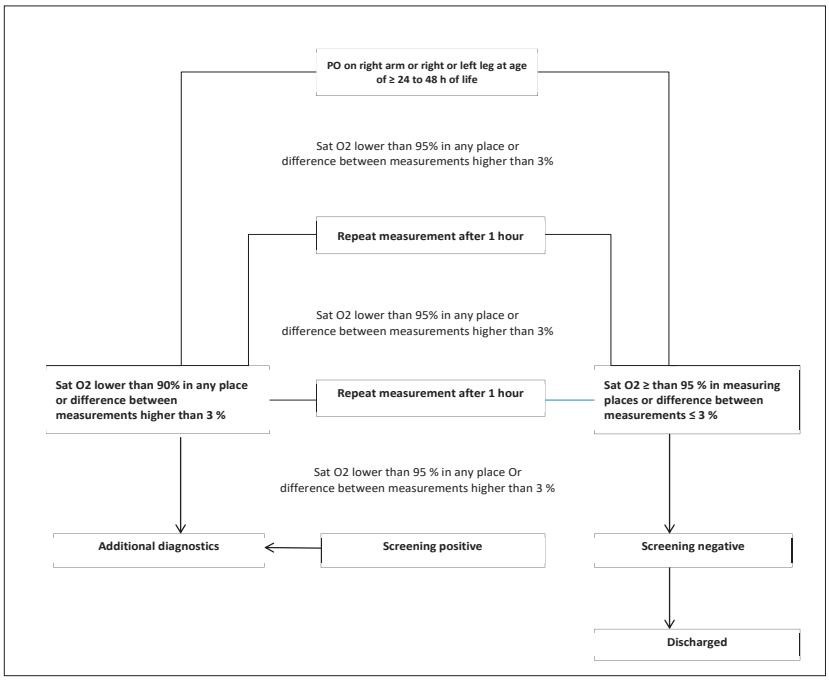

Figure 1. Algorhitm of implementing transcutaneouse pulse oximetry

Based on the parameters of clinical examination and test results of transcutaneous pulse oximetry, one of three diagnostic protocols was applied on the children. Children were discharged from the hospital based on these protocols, with or without recommendations for further control or transferred to the Department of Neonatology for further evaluation.

Protocol 1: Newborn is without cyanosis. Normal respiratory finding. Normal heart rate. Normal auscultatory heart finding. Palpable peripheral pulses. Negative screening of PO. Without degenerative stigmates.

Protocol 2 : Newborn is without cyanosis. Normal respiratory finding. Normal heart rate. Positive auscultatory finding on heart at first day of life (heart murmure) require evaluation at second day. If murmur still persists, with other parameters normal, newborn can be discharged from nursery with required control at day seven. Heart murmur persists at day seven, requires cardiologist consultation in next 4 to 6 weeks. Palpable peripheral pulses. Negative screening of PO. Without degenerative stigmates.

Protocol 3: Newborn is pale or cyanotic. Patologic respiratory finding (Dyspnoea, bradypnoea, tachypnoea). Patologic heart rate with or without heart murmur. Absent peripheral pulses. Positive screening of PO. With or without degenerative stigmates.

Children identified with protocol 1 were discharged as healthy newborns. Children identified with protocol 2 were released with a recommendation for further control in our institution. The children identified with protocol 3 were transferred to the Department of Neonatology for further diagnosis. Ultrasound examination of the heart was made by Aloka 2000 by pediatric cardiologist at the Cantonal Hospital of Bihac, multifrequency probe 3.5-5 MHz. Data were statistically analyzed, and the results shown in tables and graphs.

4. RESULTS

A large number of children in the maternity ward had normal findings of transcutaneous PO, after the first measurement. Repeated testing was made in a total of seven children (0.4%), of which six of them had normal findings after the first re-testing, and one child (0.06%) required repeated testing, with regular result finding. Out of the total number of births, the study excluded five children, because of early discharge from the maternity ward, and these were not subject to previously defined protocols. Out of the 1860 children, 115 were preterms (6.1%) and 1745 (93.8%) of term neonates. Premature infants are considered a special subgroup. Those children, because of their gestational age, are at birth transferred to the Department of Neonatology. Congenital heart defects were diagnosed using the same diagnostic agents as well as for term children (clinical examination and PO). Four children had CHD (3.48%), while the 111 premature infants had normal finding on heart (96.5%). Out of these, one child had a complex, cyanotic anomaly and three of them had non-cyanotic CHD. Pulse oximetry testing and clinical examination were conducted on 1745 full-term neonates (93.8%). There were two major groups. Normal findings were found in 1,501 respondents (80.69%). Within this group, there were no cases of congenital heart defects diagnosed at a later stage, during the follow-up period of 6 months. Second group was comprised of 244 (13,11 %) children with pathologic findings, out of which 210 children (11,2 %) were hospitalized at the Neonatology for any health related reason (41 life-threatened

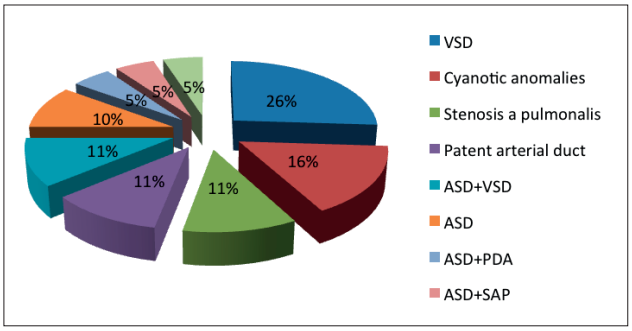

Figure 2. Congenital heart diseases diagnosed in the year 2012

children) and 34 children (1,8 %) were discharged from the maternity ward, due to the positive physical findings in the heart according to the protocol 2. These 34 children were released with a recommendation to be brought back for control on the seventh day of life. Applied methodology review of the cardiovascular system of a newborn in combination with the results of transcutaneous PO, identified 29 children (1.55%) with congenital heart defects in an annual population of live births in the maternity ward of Bihac Cantonal Hospital (1865 babies) in 2012. After examining the obtained results, we observed that findings had the sensitivity of 100% and specificity of 87% for the proposed methodology. Reevaluation of cardiac findings over a period of 6 months after the birth, revealed spontaneous closure of ventricular septal defect in the muscular part of the chamber barrier in five children and spontaneous closure of atrial septal defect in five children, which gave us a final number of 19 children (1,02% of the total number of live births) with CHD diagnosed in a neonatal period in 2012 (Figure 2).

5. DISCUSSION

The incidence of congenital heart defects is fairly constant (0.8 to 1.0% / 100 live births). In a hospital with about 1800 to 2000 births, it is calculated to be 18 to 20 children born with a congenital heart defect. This number can vary somewhat, depending on the number of small muscular ventricular septal defects and depending on the number of interatrial septal defects, since that both of them can close during first year of life (13,14). Approximately one quarter of those children will basically have some form of cyanotic CHD. Considering the growing trend for early release of children from the maternity ward and potentially "silent" clinical picture in the first days of life, there were understandable efforts to improve the diagnosis of these anomalies (15). Screening by PO, with detailed clinical examination and, if necessary, additional diagnostics, reduces the possibility of wrongful release of a child from the maternity ward with an unrecognized CHD. Due to lack of staff working with children, we decided to use a more practical version of PO screening at second day of life. It is proven that this method gives fewer false positives and requires a smaller number of repeated measurements (16). Measuring saturation is conducted by medical, previously trained staff (nurses in the child's room, midwives). In recent years, as part of neonatal care advanced education for neonatal nurses, recognition of symptoms of congenital heart disease is taught (17, 18). The measurement was conducted at two sites because it was reported in literature that the difference between the two measurements at hand and at foot higher than 3% can identify anomalies of the aortic arch or left ventricle outflow obstruction (19). We did not find such cases to confirm or deny it. Measuring only at one place could lead to having these anomalies overlooked. Clinical examination of the child, taking into account all the parameters is described in detail in the working methodology. Heart murmur was noted on the first day of life in 245 children in the maternity ward. According to protocol, the children were examined on the second day and, if necessary, on the seventh day of life (in the same institution) (20, 21). This system has reduced the number of children referred to a cardiologist to 34 children (2.2% of the total number of children with primarily murmur noted) and cardiac defect was confirmed in 17 of them. All children sent to a cardiologist after discharge from the maternity ward had the proper value PO. As expected, it was mostly about the anomalies with left-right shunt and without cyanosis. One child had tetralogy Fallot, which is a cyanotic anomaly, but with variations in the clinical picture, depending on the degree of obstruction at the level of right ventricular outflow tract. Higher degree of obstruction gives clinical picture with pronounced cyanosis. The child in our study had mild stenosis of the pulmonary artery, so it was the variant of "Pink Fallot" which can have a proper saturation, so we could not really conclude that was a false negative test of PO. A total of 210 children were moved to the Department of Neonatology for different reasons. Out of these, 41 children were in life-threatening condition. Heart disease was confirmed in 8 children. In other cases, it was the other pathologies of newborns (infection, asphyxia, neurological causes) and they also had benefited from earlier diagnosis. During the study, there was no child discharged from the maternity ward with potentially life-threatening congenital heart anomaly. There was no child subsequently admitted to our hospital with signs of developed heart disease and all defects are diagnosed in time optimal for their care.

6. CONCLUSION

The new methodology review of the cardiovascular system in a population of newborns, using the protocol for measuring arterial saturation, is a modern algorithm for early detection of congenital heart anomalies. The concept is simple, affordable and reproducible in most maternity wards. In this way we can improve diagnosis of congenital heart defects, especially in circumstances where there is no developed prenatal diagnostics and screening methods using echocardiography are limited due to economic factors.

- Conflict of interest: none declared.

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