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ORIGINAL ARTICLE

IMPORTANCE OF TEMPERATURE, OXYGEN SATURATION, PERFUSION, SUGAR (TOPS) PARAMETERS AND THE CONCEPT OF TOPS SCORE FOR NEONATAL TRANSPORT IN INDIA - A PILOT PROJECT

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ABSTRACT

Aim: The importance of TOPS parameters (temperature, oxygen saturation, perfusion and sugar) in predicting neonatal outcome is well established and TOPS parameters on admission reflect the care taken before and during transport of neonate while referral. The objective was to introduce the concept of TOPS score from TOPS parameters and to formulate optimal TOPS score (score at which neonatal outcome is the best) which will help regional health centers and peripheral health centers (PHCs) in safely referring newborns.

Method: This observational study was carried out from August 2013- July 2014. TOPS parameters were taken on admission of neonates referred to our center and outcome of these neonates were noted as survived/dead. When no TOPS parameters were deranged, it was scored as 0. When 1 TOPS parameter was deranged, the score of 1 was given. When 2 TOPS parameters were deranged, score of 2 was given and so on. Optimal TOPS score was defined as the score at which neonatal outcome was best. Effect of TOPS score and outcome was determined

Result: Five hundred twenty nine neonates were included in the study, of which 417 (78.8%) survived and 112 (21.2%) died. Hypothermia was present in 315 (59.6%), hypoxemia in 252 (47.6%), prolonged perfusion in 230 (43.5%) and hypoglycemia in 78 (14.7%) babies. One hundred forty five babies had score of 0 of which all survived, this was considered optimal TOPS score. Single TOPS parameter (score 1) was seen in 120 babies of which 117 (97.5%) survived, 91 babies had derangement of 2 TOPS parameters (score 2) of which 79 (86.8%) survived, 119 babies had derangement of 3 TOPS parameters (score 3) of which 65 (54.6%) survived and 54 babies had derangement of all the 4 TOPS parameters (score 4) of which 43 (79.6%) babies survived.

Conclusion: Concept of TOPS score is introduced for stressing that derangement of TOPS parameters when found together is more harmful and significantly increases the risk of neonatal mortality. TOPS score sensitizes the need to attempt at achieving optimal TOPS score by taking care of the easily correctable conditions of hypothermia, hypoxemia, poor perfusion and hypoglycemia before and during the referral of neonate.

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Introduction

Infant mortality rate (IMR) is considered as powerful predictor of nation's development. Various national health programmes and schemes have been implemented to improvise maternal and child health. However we still see many newborns dying in hands of caretaker awaiting place in neonatal intensive care unit (NICU) while others cannot reach health care facility in good condition due to lack of proper referral services in most parts of our country. Though institutional delivery and in-utero transport of newborn is safest but unfortunately preterm delivery and perinatal illness cannot always be anticipated resulting in continued need of transfer of these babies after delivery. (1) Previous studies have implicated hypothermia as the commonest morbidity in babies before arrival at hospital. (2) It is known that poor peripheral circulation compound the problems already existing in a hypothermic baby. Hypothermia, hypoglycemia and delayed capillary filling time (CFT) are common in out of hospital deliveries. Maintenance of oxygenation and euglycemia during transport and on arrival at emergency goes long way in reducing the mortality. (3) This study was undertaken to confirm importance of maintaining TOPS parameters (Temperature, oxygen saturation, perfusion and sugar) and its correlation with neonatal outcome. TOPS parameters on admission reflect care taken before and during transport of neonate. The objective was to formulate concept of optimal TOPS score from TOPS parameters which can be used during neonatal transfer from periphery to tertiary centres. TOPS physiology predicting neonatal

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outcome has been studied infrequently in the past and the concept of TOPS score based on TOPS parameters never proposed in literature. Such score can be very useful in resource limited settings to optimize neonatal outcome during referral. Parameters of TOPS physiology can be easily remembered when put into a score which will be of utmost importance for paramedics who are mainly involved in neonatal transport and care during referral. Such score can bring objectivity to communication of neonatal condition before and during transport of neonate.

Methods & Materials

An observational study was conducted in the Department of Pediatrics of tertiary care center in India and permission was obtained from Institutional Ethical Committee. The study protocol was fully explained to parents/guardian and written informed consent was obtained. All neonates [< 29 days] transferred to our NICU were enrolled in study during study period of one year from August 2013- July 2014. These neonates were babies born at home, born at government centers [primary health-care center, district hospitals] or private hospitals/nursing homes and referred to our hospital for management. A Neonatal case proforma was used to record information regarding maternal details, birth details, interventions before transportation [intravenous fluid/feed , oxygen administration, care of temperature, resuscitation details], details of treatment during transportation [intravenous fluid/ feed, oxygen administration, kangaroo mother care, care of temperature] and neonatal condition at arrival. History pertaining to maternal details of gestational age [as per last menstrual date], mode of delivery, birth details including place of birth [home/ government institution/ private hospital/ nursing home], personnel who conducted the delivery [untrained or trained health personnel], birth weight, APGAR score [if available] and other resuscitation details were recorded. Transport details such as mode of transport, time taken to reach the hospital were recorded. On admission, detailed clinical assessment of the baby was performed and recorded. Gestational age was noted from records and reconfirmed with modified Ballard score if < 7 days of age. Weight of the baby was taken on digital weighing machine with minimum 0.001 kg accuracy as the weight on admission. Temperature was recorded using the rectal thermometer and the baby was placed in overhead warmer. Temperature <36.50C was considered hypothermia. Hypothermia was classified into mild (36-36.40C), moderate (32-35.90C), severe (<320C) categories according to the World Health Organization (WHO) classification of hypothermia. (4) Oxygen saturation was measured using pulse oximeter (Candour medical model number-SN/05AF000663 with a pediatric probe). In cases of shock or acidosis or difficulty in obtaining pulse oximeter reading, arterial blood gas analysis was used to document arterial saturation values. Pulse oximeter oxygen saturation/ arterial oxygen saturation values < 90 % was considered hypoxemia. (5) Capillary refill measurements were performed by applying minimal pressure (defined as the pressure which produced blanching) with the examiner's thumb on the sternum of neonate. Applied pressing time was 5 seconds. (6) CRT was measured in every patient by simultaneous activation of stopwatch and application of minimal pressure until skin blanched. At the end of 5 seconds pressure was released. When skin colour returned to baseline the stopwatch was inactivated. The patients were assessed lying supine in radiant warmer. If for any reasons measurement had to be repeated, period of 30 seconds was allowed before the next attempt. Capillary refill time > 3 seconds was considered as poor perfusion. (6) Blood glucose was measured using reagent strips and One touch Select glucometer (model number- cr 2032) with sample taken by heel prick on admission to NICU. Whenever heel prick glucose was low (<40 mg/dl), blood glucose was confirmed with Glucose oxidase (calorimetric method). Blood glucose value of < 40 mg/dl on reagent strips was considered hypoglycemia. (7) All babies were investigated and managed based on their admission diagnosis using a standard protocol. (8) Outcome was recorded based on whether babies survived or died.

When no TOPS parameters were deranged, it was scored as 0. When 1 TOPS parameter was deranged, the score of 1 was given. When 2 TOPS parameters were deranged, score of 2 was given and so on. Optimal TOPS score was defined as the score at which neonatal outcome was best. Effect of TOPS score and outcome was determined.

Results

Out of 529 neonates referred to us, 417 (78.8%) survived and 112 (21.2%) died. The average weight on admission of those who died was 1585.7 gm whereas average weight of those who survived was 2039.4 gm. There were 314 (59.3%) preterm and 215 (40.7%) full term babies. Mortality was more in preterm (82 out of 314; 26.1%) as compared to full term babies (30 out of 215; 13.9%) ($p < 0.001$). Hypothermia on admission was present in 315 (59.6%) babies, out of which 104 babies had mild hypothermia of which 94 (90.4%) babies survived, 211 babies had moderate hypothermia of which 116 (55%) babies survived and none had severe hypothermia ($p<0.001$). Hypoxemia was found in 252 (47.6%) babies, 146 (57.9%) of which survived. Oxygen saturation was more than 90% in the remaining 277 (52.4%) babies, out of which 271 (97.8%) babies survived ($p < 0.001$). Perfusion was normal in 299 (56.5%) babies, out of which 293 (98%) survived and 6 (2%) died. Perfusion > 3 sec was found in remaining 230 (43.5%) babies, of which 124 (53.9%) babies survived ($p < 0.001$). Blood sugar was low in 78 (14.7%) babies of which 34 (43.6%) babies survived. Blood glucose was normal in the rest 451 (85.3%) babies, out of which 383 (84.9%) babies survived ($p < 0.001$).

Hypothermia had 14.79 odd's ratio for mortality, hypoxemia had odd's ratio of 32.79 for mortality, delayed perfusion had 41.74 odd's ratio for mortality and hypoglycemia had 7.29 odd's ratio of mortality. This shows that delayed capillary refill time (poor perfusion) carries maximum risk for mortality. Odd's ratio for mortality with combined hypothermia and hypoxemia was 26.17, whereas that for hypothermia + hypoxemia + poor perfusion was 34.85 and adding hypoglycemia to them made it 23.

TOPS score of 0 was seen in 145 babies, of which all survived, 120 babies had derangement of single TOPS parameter (score 1), of which 117 (97.5%) survived, 91 babies had derangement of 2 TOPS parameters (score 2) of which 79 (86.8%) survived, 119 babies had derangement of 3 TOPS parameters (score 3) of which 65 (54.6%) survived and 54 babies had derangement of all the 4 TOPS parameters (score 4) of which 43 (79.6%) babies survived.

Discussion

No previous study has put TOPS (temperature, oxygen saturation, perfusion, sugar) parameters into a score as other detailed and well calibrated scores like SNAP (Score for Neonatal Acute physiology), SNAPPE (Score for Neonatal Acute physiology- Perinatal extension), CRIB (Clinical risk Index for babies) are available. Mathur et al (9) has shown that TOPS has an equally good prediction for mortality as SNAP II and can be used as a simple and useful method of assessment of risk of fatality that can be assessed immediately, at admission. Parameters of TOPS physiology can be easily remembered when put into a score which can be of utmost importance for paramedics who are mainly involved in neonatal transport and care during referral. Such score can bring objectivity to communication of neonatal condition before and during transport of neonate. This will be great milestone in improving standard of care for neonatal transport across the country.

TOPS parameters are very important physiological parameters of a neonate and derangement of even single TOPS parameter can adversely affect the outcome of neonate. When more than one TOPS parameter is deranged, the risk for mortality goes on increasing. Extended periods of hypothermia in a neonate can be detrimental as can cause harmful side effects which include hypoglycemia, respiratory distress, hypoxia, coagulation defects, acute renal failure and necrotizing enterocolitis which can increase the risk for neonatal mortality. (10) Sehgal et al (3) found hypothermia on admission to be independently associated with neonatal mortality on logistic regression analysis with Odd's ratio of 47.24. In the study by Buch et al, (11) out of the 48 babies who died, 38 (79.1%) had hypothermia; odd's ratio for mortality due to hypothermia were 3.65 (p value = 0.004). Similar association was documented by Mathur et al with odd's ratio for mortality with hypothermia being 5.2 (p value < 0.001). (9) Singh et al also documented hypothermia to be significant risk factor for neonatal mortality (p value < 0.001). (12)

Reopening of fetal right-to-left shunts is probably the single most important cause of life-threatening hypoxia in the newborn period which can occur due to the various respiratory illnesses in the neonatal period. Hypoxia leads to lactic acidosis which can impair cardiac function, increase pulmonary vascular resistance and decrease the synthesis of clotting factors which can lead to disseminated intravascular coagulation. (13) Unlike hypothermia and hypoglycemia which are easy to correct, management of hypoxia can be difficult at times and require advanced treatment support like mechanical ventilation. This can be the reason of higher Odd's for mortality with hypoxia as compared to hypothermia and hypoglycemia. Sehgal et al (3) also observed that cyanosis in their study had maximum Odd's ratio of 309.33 for mortality. Similarly, Narang et al (14) found cyanosis to be present in 58 out of their 95 neonates (61.1%) and the relation to mortality was significant (p value < 0.01) and Buch et al (11) observed that out of the 48 babies who died, 21 (43.8%) had cyanosis which was significant (p value 0.009).

Mathur et al (9) observed that poor perfusion had maximum odds for mortality (29.6, p value < 0.001), as is seen in our study. In the study by Narang et al, (13) as many as 69.3% babies had prolonged capillary refill time and it was seen that neonates who received interventions (intravenous fluid/oxygen administration/ care of temperature) had significantly reduced odd's for mortality 0.21 (p value < 0.01). Delayed capillary refill time is a marker of poor perfusion which can be due to hypovolemia, decreased cardiac output and hypotension due to peripheral vasodilation. It indicates circulatory collapse and can be harmful to end organs causing ischemic damage. It is associated with intraventricular hemorrhage, necrotizing enterocolitis and renal failure in preterm neonates which can lead to increased neonatal mortality. (15) Decompensated shock can result from prolonged hypo-perfusion which is refractory to treatment and can explain the highest odd's for mortality with delayed capillary filling time.

Hypoglycemia is quite common in babies born outside and referred. The reasons could be deliberate withholding of feeds thinking that the colostrum is too thick to be digested, replacement of breast-feeds by other pre-lacteal feeds, clinical reasons such as respiratory distress, sepsis, asphyxia, etc. Hypoglycemia not only affects immediate survival but also predicts abnormal outcome in terms of Neuro Biologic Risk Score (NBRS). (3) Similarly hypoglycemia is considered as independent risk factor for neonatal mortality as also observed by Sehgal et al (odd's ratio for mortality 14.43) and Mathur et al (odd's ratio for mortality 2.24, p value 0.02). (3,9)

In our study, with increasing TOPS score, mortality increased. However the mortality with TOPS score of 4 was less when compared to score 3. This could have happened as factors other than TOPS parameters like birth weight, gestational age, NICU course and associated illness (Respiratory distress syndrome, meconium aspiration syndrome, birth asphyxia, necrotizing enterocolitis etc.) affect neonatal mortality. Also it can be seen that all parameters of the score have different individual Odd's for mortality and hence severity of individual parameter can affect the end result (mortality) and skew the comparison. TOPS score is a basic and simplistic concept which needs further development for its application for clinicians as to predict neonatal mortality.

Limitations of the study - Confounding factors like birth weight, gestational age and associated illnesses were not assessed while comparing TOPS score and neonatal mortality. Further studies are needed to identify strength of individual parameters of TOPS score in relation to neonatal mortality to increase its objectivity and use as a prognostic indicator.

Conclusion

Concept of TOPS score is introduced for stressing that derangement of TOPS parameters when found together is more harmful and significantly increases the risk of neonatal mortality. TOPS score sensitizes the need to attempt at achieving optimal TOPS score by taking care of the easily correctable conditions of hypothermia, hypoxemia, poor perfusion and hypoglycemia before and during the referral of neonate.

Compliance with Ethical Standards

Ethics statement: The study was approved by the institute's ethics review board. Informed consent was taken from the parents/guardians.

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References :

1. Kempley ST, Sinha AK, Thames Regional Perinatal G. Census of neonatal transfers in London and the South East of England. Arch Dis Child Fetal Neonatal Ed. 2004;89(6):F521-6.
2. Bhoopalam PS, Watkinson M. Babies born before arrival at hospital. Br J Obstet Gynaecol. 1991;98(1):57-64.
3. Sehgal A, Roy MS, Dubey NK, Jyothi MC. Factors contributing to outcome in newborns delivered out of hospital and referred to a teaching institution. Indian Pediatr. 2001;38:1289-94.
4. World Health Organization. Thermal protection of the newborn: A practical guide. Available at URL: http://www.who.int/maternal_child_adolescent/documents/ws42097th/en/. Accessed on 5th June 2018
5. Stenson B, Brocklehurst P, Tarnow-Mordi W; U.K. BOOST II trial; Australian BOOST II trial; New Zealand BOOST II trial. Increased 36-week survival with high oxygen saturation target in extremely preterm infants. N Engl J Med. 2011;364:1680-2.
6. Strozik KS, Pieper CH, Roller J. Capillary refilling time in newborn babies: normal values. Arch Dis Child Fetal Neonatal Ed. 1997;76(3):F193-6.
7. Cornblath M, Hawdon JM, Williams AF, Aynsley-Green A, Ward-Platt MP, Schwartz R, et al. Controversies regarding definition of neonatal hypoglycemia: suggested operational thresholds. Pediatrics. 2000;105:1141-5.
8. Clinical Protocols in Neonatology. Delhi2005. Available from: http://www.newbornwhocc.org/clinical_protocols.htm. Accessed on 5th June 2018
9. Mathur NB, Arora D. Role of TOPS (a simplified assessment of neonatal acute physiology) in predicting mortality in transported neonates. Acta Paediatrica. 2007;96(2):172-5.
10. Nayeri FN. Hypothermia at Birth and its Associated Complications in Newborns: a Follow up Study Iranian J Publ health. 2006;35(1):48-52.
11. Buch PM MAM, Chudasama RK , Doshi SK. Status of Newborn Transport in Periphery and Risk Factors of Neonatal Mortality among Referred Newborns. J Pharmaceutical Biomed Sci. 2012;16:1-5.
12. Singh H, Singh D, Jain BK. Transport of referred sick neonates: how far from ideal? Indian Pediatr. 1996;33(10):851-3.
13. Reynolds EO. Hypoxia in the newborn infant. J Clin Pathol Suppl (R Coll Pathol). 1977; 11: 134–141.
14. Narang M, Kaushik JS, Sharma AK, Faridi MM. Predictors of mortality among the neonates transported to referral centre in Delhi, India. Indian J Public Health. 2013;57(2):100-4.
15. Dempsey EM, Barrington KJ. Evaluation and Treatment of Hypotension in Premature Infants. Clin Perinatol. 2009;36:75-85