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Original Research Article

The predictive accuracy of hypoxic scoring for prediction of adverse outcome in neonates born with asphyxia

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ABSTRACT

Background: Birth asphyxia is a major contributor to neonatal mortality. Fetal hypoxia followed by asphyxia is common cause of brain injury in term infants. Hypoxia score has shown to be accurate enough to predict adverse outcome in asphyxiated neonates. But controversies exist regarding predictive accuracy of hypoxia score. So we conducted this study. Objective to assess the predictive accuracy of hypoxic scoring for prediction of adverse outcome in neonates born with asphyxia.
Methods: 170 neonates were screed for hypoxia score. Neonates were labelled as positive or negative. Then all neonates were followed-up for 7 days. If neonate died within 7days, then case was confirmed as positive or negative. Data was analysed by using SPSS 20. 2x2 table was developed to calculate sensitivity, specificity, PPV, NPV and predictive accuracy of hypoxia score.
Results: The mean Apgar score at birth was 5.01±0.83. The sensitivity of hypoxia score was 87.8%, specificity was 90.9%, PPV was 90%, NPV was 88.9% while predictive accuracy was 89.4% taking actual adverse outcome as gold standard.
Conclusions: The predictive accuracy of hypoxia score was high for prediction of adverse outcome in asphyxiated neonates.

Keywords: Adverse outcome, Asphyxia, Hypoxic scoring, Neonates, Predictive accuracy

INTRODUCTION

Perinatal asphyxia or neonatal asphyxia is the medical condition resulting from deprivation of oxygen to a newborn infant that lasts long enough during the birth process to cause physical harm, usually to the brain.[1] The majority of infants who are exposed to perinatal hypoxia-ischemia will recover quickly and go on to have a completely normal survival, a proportion will suffer from an evolving clinical encephalopathy termed hypoxic-ischemic encephalopathy (HIE). Hypoxic-Ischemic Encephalopathy is a major contributor to neonatal death and morbidity.[2] Approximately 50%-80% of neonatal encephalopathy (NE) can be attributed to hypoxia-ischaemia and given the potential benefit of early treatment; the need to identify infants with hypoxic-ischaemic induced encephalopathy is becoming increasingly important. An estimated 23% of the 4 million neonatal deaths due to Hypoxic-Ischemic Encephalopathy and 8% of all deaths at <5 years of age

throughout the world each year are associated with signs of asphyxia at birth.[1]

Intrapartum fetal hypoxia followed by Hypoxic-Ischemic Encephalopathy is a common cause of potentially avoidable brain injury in term infants.[2] The incidence of Hypoxic-Ischemic Encephalopathy in developed countries is estimated to be 1.5 per 1,000 live births.[3] Estimates in developing countries range from 2.3-26.5 per 1,000 live births.[4] The mortality rate of birth asphyxia neonates is 13.3% among neonatal intensive care unit admitted cases.[5]

A recent meta-analysis found that therapeutic hypothermia commenced by age 6 hours for infants with moderate or severe Hypoxic-Ischemic Encephalopathy, significantly reduces death or disability: in three studies an abnormal amplitude integrated electro-encephalogram was required as an additional criterion for cooling.[6]

An early clinical score predicting an abnormal amplitude-integrated electroencephalogram or moderate-severe Hypoxic-Ischemic Encephalopathy may allow rapid triage of infants for therapeutic hypothermia.[2] One study has reported that for prediction of adverse outcome, the specificity of hypoxia score was found to be 96% and sensitivity of 71%.[7] But another study has reported that for prediction of adverse outcome, the specificity of hypoxia score was found to be 100% and sensitivity of 14%.[8]

Rationale of this study is to assess the predictive accuracy of hypoxic scoring for prediction of adverse outcome in neonates born with asphyxia. Literature has reported that hypoxic score can help in prediction of outcome of neonate presenting with Hypoxic-Ischemic Encephalopathy or birth asphyxia. But controversial results have been noticed in literature. The results of this study might be implemented in local setting in the future. This will help to improve this practice and knowledge.

METHODS

In this cross sectional study, 170 neonates fulfilling the selection criteria were included in the study from emergency of Department of Paediatric Medicine, The Children's Hospital and Institute of Child Health Lahore. An informed consent was taken from parents.

Neonates of either gender presenting with asphyxia (as per operational definition) admitted within 24 hrs of delivery were included in this study.

Neonates born with obvious congenital malformations (on clinical examination) and preterm neonates (before gestational age of 37 weeks) were excluded because the Apgar scores of non-asphyxiated preterm babies are normally low due to poor neurological maturity Demographic information (name, gestational age at birth, gender, birth weight, Apgar score) was obtained. Then all neonates were screened for hypoxia score by researcher himself.

Neonates were labelled as positive or negative for adverse outcome (as per operational definition). Then all neonates were admitted in neonatal unit and were followed-up there for 7 days of admission. If neonate died within 7 days, then case was confirmed as positive or negative for adverse outcome (as per operational definition). All the information was recorded on proforma.

Data analysis

Data was entered and analysed by using SPSS version 20. Mean and standard deviation were calculated for quantitative variables like gestational age, birth weight and Apgar score. Qualitative variables like gender and adverse outcome (on hypoxia score and actual event) was presented as frequency and percentage. 2x2 tables was generated to calculate sensitivity, specificity, PPV, NPV and predictive accuracy of hypoxia score taking adverse outcome as gold standard. Data was stratified for gestational age, gender, birth weight and Apgar score at presentation. Post-stratification, 2x2 tables was generated to calculate sensitivity, specificity, PPV, NPV and predictive accuracy of hypoxia score for stratified groups.

RESULTS

A total of 170 neonates were assessed. Out of these 170 neonates, the mean gestational age of neonates was 39.68 weeks with standard deviation of ±1.10 weeks while minimum gestational age was 38 weeks and maximum was 41 weeks. Most of the mothers of the newborn with asphyxia were primiparous, unbooked and presented with prolonged obstructed labor.

Majority of the newborns were of full term, of normal birth weight and delivered in the hospital mostly through an emergency Caesarean section. The mean Apgar score at birth was 5.01±0.83. Minimum Apgar score was 4 while maximum Apgar score was 6. The sensitivity of hypoxia score was 87.8%, specificity was 90.9%, PPV was 90%, NPV was 88.9% while predictive accuracy was 89.4% taking actual adverse outcome as gold standard.

The neonates having gestational age between 38-39weeks, the sensitivity of hypoxia score was found to be 87.8%, specificity was 87.5%, PPV was 90%, NPV was 84.8% while predictive accuracy was 87.7%. In neonates, born between 40-41weeks, the sensitivity of hypoxia score was 87.8%, specificity was 92.9%, PPV was 90%, NPV was 91.2% while predictive accuracy was 90.7% (Table 1).

The neonates weighing 2000-2500grams, the sensitivity of hypoxia score was 80%, specificity was 91.7%, PPV was 92.3%, NPV was 78.5% while predictive accuracy was 85.2%. The neonates who weighed 2501-3000grams,

the sensitivity of hypoxia score was 88.5%, specificity was 94.4%, PPV was 92%, NPV was 91.9% while predictive accuracy was 91.9%. The neonates weighing 3001-3500grams, the sensitivity of hypoxia score was 96.2%, specificity was 85.7%, PPV was 86.2%, NPV was 96% while predictive accuracy was 90.7% (Table 2).

Table 1: Accuracy of hypoxia score for adverse outcome stratified for gestational age.

Gestational age	Adverse outcome on hypoxia score	Adverse outcome occurs		Total	Sen	Spec	PPV	NPV	Accuracy
		Positive	Negative						
38-39	Positive	36	4	40	87.8	87.5	90	84.8	87.7
	Negative	5	28	33					
	Total	41	32	73					
40-41	Positive	36	4	40	87.8	92.9	90	91.2	90.7
	Negative	5	52	57					
	Total	41	56	97					

‡ Sen: sensitivity, Spec: specificity, PPV: positive predictive value, NPV: negative predictive value

Table 2: Accuracy of hypoxia score for adverse outcome stratified for birthweight.

Birthweight	Adverse outcome on hypoxia score	Adverse outcome occurs		Total	Sen	Spec	PPV	NPV	Accuracy
		Positive	Negative						
2000-2500	Positive	24	2	26	80	91.7	92.3	78.5	85.2
	Negative	6	22	28					
	Total	30	24	54					
2501-3000	Positive	23	2	25	88.5	94.4	92	91.9	91.9
	Negative	3	34	37					
	Total	26	36	62					
3001-3500	Positive	25	4	29	96.2	85.7	86.2	96	90.7
	Negative	1	24	25					
	Total	26	28	54					

‡ Sen: sensitivity, Spec: specificity, PPV: positive predictive value, NPV: negative predictive value

Table 3: Accuracy of hypoxia score for adverse outcome stratified for apgar score.

Apgar score	Adverse outcome on hypoxia score	Adverse outcome occurs		Total	Sen	Spec	PPV	NPV	Accuracy
		Positive	Negative						
4	Positive	24	2	26	77.4	92.3	92.3	77.4	84.2
	Negative	7	24	31					
	Total	31	26	57					
5	Positive	22	2	24	95.7	93.5	91.7	96.7	94.4
	Negative	1	29	30					
	Total	23	31	54					
6	Positive	26	4	30	92.9	87.1	86.7	93.1	89.8
	Negative	2	27	29					
	Total	28	31	59					

‡ Sen: sensitivity, Spec: specificity, PPV: positive predictive value, NPV: negative predictive value

The neonates with Apgar score of 4, the sensitivity of hypoxia score was found to be 77.4%, specificity was 92.3%, PPV was 92.3%, NPV was 77.4% while predictive accuracy was 84.2%.

In neonates with Apgar score 5, the sensitivity of hypoxia score was 95.7%, specificity was 93.5%, PPV was 91.7%, NPV was 96.7% while predictive accuracy was 94.4%.

In neonates with Apgar score 6, the sensitivity of hypoxia score was 92.9%, specificity was 87.1%, PPV was 86.7%, NPV was 93.1% while predictive accuracy was 89.8% (Table 3).

DISCUSSION

Hypoxic ischemic encephalopathy is a major complication of perinatal asphyxia, with high morbidity, mortality and neurologic sequelae as cerebral palsy, mostly in poor or developing countries.[9,10] Despite therapeutic hypothermia 30-70% of newborns with moderate or severe hypoxic ischemic encephalopathy will die or survive with significant long-term impairments.[11,12] Hypoxic ischemic injury is one of the causes of depressed Apgar scores. Apgar scores have long been considered to be correlated with prognosis. HIE must be differentiated from other causes of neonatal encephalopathy (NE), such as sepsis, meningitis or a metabolic disorders. There may be a high suspicion of hypoxic-ischaemic injury following a known perinatal insult such as placental abruption or cord accident or if typical clinical signs, biochemical evidence of metabolic acidosis or depressed Apgar scores are present. The need to identify infants with hypoxic-ischaemic induced encephalopathy is becoming increasingly important.[13-15]

A study conducted by Dalili et al. in 2015 showed that newly proposed Combined-Apgar score was found to be highly sensitive and specific in predicting birth asphyxia, with a high PPV and NPV. In addition a low 5- minute Combined-Apgar score was significantly associated with major adverse early neurologic outcomes in the asphyxiated neonates, which was independent of gestational age. The newly proposed Combined-Apgar score that was introduced in 2012 by changing and combining the Conventional, Specified and Expanded Apgar scores, to solve the limitations of using each of these scores alone, is highly sensitive and specific in predicting birth asphyxia with a high PPV and NPV, and also is a good predictor of the occurrence of HIE and IVH in asphyxiated neonates.[16]

The classification method of Sarnat and Sarnat has commonly been used to rapidly and correctly establish the severity of hypoxic ischemic encephalopathy.

It can be suggested that patients with mild hypoxic ischemic Encephalopathy are more likely to have better prognosis due to the high negative predictive value (90.9%).[17,18]

One study has reported that for prediction of adverse outcome, a peak score of ≥15 had a PPV of 92% and a NPV of 82% for abnormal outcome, with a sensitivity and specificity of 71% and 96%, respectively.[7] But another study has reported that for prediction of adverse outcome, the specificity of hypoxia score was found to be 100% and sensitivity of 14%.

Another study showed that the sensitivity and specificity of hypoxia soring was 84% and 70%, respectively for prediction of adverse neonatal outcome. One study reported sensitivity and specificity of hypoxia soring was 97% and 71%, respectively for prediction of adverse neonatal outcome.[2]

Very little work has been done in this regard. So, further studies are required with large sample size to confirm he evidence.

CONCLUSION

Thus, the predictive accuracy of hypoxia score was high for prediction of adverse outcome in asphyxiated neonates. Now we have got the evidence regarding predictive accuracy of hypoxia score. In future, we can now implement the use of hypoxic score for prediction of adverse or good outcome of neonate presenting with asphyxia.

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REFERENCES

1. Zhou WH, Cheng GQ, Shao XM, Liu XZ, Shan RB, et al. Selective head cooling with mild systemic hypothermia after neonatal hypoxic-ischemic encephalopathy: a multicenter randomized controlled trial in China. J Pediatr. 2010;157(3):367-72.
2. Horn AR, Swingler GH, Myer L, Linley LL, Raban MS, Joolay Y, et al. Early clinical signs in neonates with hypoxic ischemic encephalopathy predict an abnormal amplitude-integrated electroencephalogram at age 6 hours. BMC Pediatr. 2013;13(1):52.
3. Kurinczuk JJ, White-Koning M, Badawi N. Epidemiology of neonatal encephalopathy and hypoxic–ischaemic encephalopathy. Early Human Development. 2010;86(6):329-38.
4. Horn AR, Swingler GH, Myer L, Harrison MC, Linley LL, Nelson C, et al. Defining hypoxic ischemic encephalopathy in newborn infants: benchmarking in a South African population. J Perinat Med. 2013;41(2):211-7.
5. Padayachee N, Ballot DE. Outcomes of neonates with perinatal asphyxia at a tertiary academic hospital in Johannesburg, South Africa. South African J Child Health. 2013;7(3):89-94.
6. Tagin MA, Woolcott CG, Vincer MJ, Whyte RK, Stinson DA. Hypothermia for neonatal hypoxic ischemic encephalopathy: an updated systematic review and meta-analysis. Arch Pediatr Adolescent Med. 2012;166(6):558-66.
7. Thompson CM, Puterman AS, Linley LL, Hann FM, Van der Elst CW, Molteno CD ,et al. The value of a scoring system for hypoxic ischaemic encephalopathy in predicting neurodevelopmental outcome. Acta Paediatr. 1997;86(7):757-61.

8. Mwakyusa SD, Manji KP, Massawe AW. The hypoxic ischaemic encephalopathy score in predicting neurodevelopmental outcomes among infants with birth asphyxia at the Muhimbili National Hospital, Dar-es-Salaam, Tanzania. J Trop Pediatr. 2008;55(1):8-14.
9. Merchant N, Azzopardi D. Early predictors of outcome in infants treated with hypothermia for hypoxic–ischaemic encephalopathy. Develop Med Child Neurol. 2015;57:8-16.
10. Perez JM, Golombek SG, Sola A. Clinical hypoxic-ischemic encephalopathy score of the Iberoamerican Society of Neonatology (Siben): A new proposal for diagnosis and management. Revista da Associação Médica Brasileira. 2017;63(1):64-9.
11. Agut T, León M, Rebollo M, Muchart J, Arca G, Garcia-Alix A. Early identification of brain injury in infants with hypoxic ischemic encephalopathy at high risk for severe impairments: accuracy of MRI performed in the first days of life. BMC Pediatr. 2014;14(1):177.
12. Ahearne CE, Boylan GB, Murray DM. Short and long term prognosis in perinatal asphyxia: An update. World J Clini Pediatr. 2016;5(1):67.
13. Ilah BG, Aminu MS, Musa A, Adelakun MB, Adeniji AO, Kolawole T. Prevalence and risk factors for perinatal asphyxia as seen at a specialist hospital in Gusau, Nigeria. Sub-Saharan African J Med. 2015;2(2):64.
14. Sabir H, Cowan FM. Prediction of outcome methods assessing short-and long-term outcome after therapeutic hypothermia. In Seminars in Fetal and Neonatal Med. 2015;20(2):115-21.
15. Weeke LC, Groenendaal F, Mudigonda K, Blennow M, Lequin MH, Meiners LC, et al. A novel magnetic resonance imaging score predicts neurodevelopmental outcome after perinatal asphyxia and therapeutic hypothermia. J Pediatr. 2018;192:33-40.
16. Dalili H, Nili F, Sheikh M, Hardani AK, Shariat M, Nayeri F. Comparison of the four proposed Apgar scoring systems in the assessment of birth asphyxia and adverse early neurologic outcomes. PloS one. 2015;10(3):1371.
17. Chalak LF, Sánchez PJ, Adams-Huet B, Laptook AR, Heyne RJ, Rosenfeld CR. Biomarkers for severity of neonatal hypoxic-ischemic encephalopathy and outcomes in newborns receiving hypothermia therapy. J Pediatr. 2014;164(3):468-74.
18. Polat M, Şimşek A, Tansuğ N, Sezer RG, Özkol M, Başpınar P, et al. Prediction of neurodevelopmental outcome in term neonates with hypoxic-ischemic encephalopathy. Europ J Paediatr Neurol. 2013;17(3):288-93.

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