IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 25, Issue 2 Ser. 1 (February. 2026), PP 01-05
www.iosrjournals.org

Determine The Relationship Between Various Clinical Conditions And Biochemical Factors With The Outcome Of Ventilated Neonates

Hossain ME, Rana AKMS, Rahman ASMA, Islam MA
Assistant Professor, Department Of Pediatrics, Bangladesh Shishu Hospital & Institute, Dhaka, Bangladesh
Medical Officer, Bangladesh Shishu Hospital & Institute, Dhaka, Bangladesh
Medical Officer, Bangladesh Shishu Hospital & Institute, Dhaka, Bangladesh
Professor, Department Of Pediatrics, Dhaka Shishu Hospital, Dhaka, Bangladesh

Abstract
Introduction: *Mechanical ventilation is a life-saving intervention in critically ill neonates but is associated with high mortality, particularly in low-resource settings. Clinical conditions, metabolic disturbances, and complications during ventilation may significantly influence neonatal outcomes. Understanding these factors is crucial to improving survival rates.*
Aim of the Study: *This study aimed to observe the relationship between various clinical conditions and biochemical factors with the outcome of ventilated neonates admitted to the ICU.*
Methods: *This prospective observational study was conducted in the ICU of Dhaka Shishu Hospital from June 2007 to March 2008. A total of 60 neonates requiring mechanical ventilation were enrolled. Baseline and perinatal characteristics, primary clinical diagnoses, arterial blood gas (ABG) parameters, and biochemical markers (serum sodium, potassium, blood urea, creatinine, glucose) were recorded. Complications during ventilation were also monitored. Outcomes were classified as improved (survived) or died. Data were analyzed using independent t-tests and chi-square tests, with $p<0.05$ considered significant.*
Results: *Among 60 ventilated neonates, 23 (38.3%) improved and 37 (61.7%) died. No significant association was observed between survival and sex, gestational age, or birth weight ($p>0.05$). Common diagnoses were birth asphyxia (30%), sepsis (23.3%), and RDS (15%); diagnosis was not significantly associated with outcome. ABG abnormalities (lower pH, PO_2, bicarbonate; higher PCO_2 and base deficit) were strongly associated with mortality ($p<0.001$). Non-survivors had lower serum sodium and glucose and higher potassium, urea, and creatinine ($p<0.01$). The occurrence of any complication during ventilation was significantly linked with death ($p=0.006$).*
Conclusion: *Metabolic derangements, renal dysfunction, and complications during ventilation are strong predictors of mortality in ventilated neonates. Early detection and correction of these abnormalities, along with careful monitoring, can improve survival outcomes.*
Keywords: *Ventilated neonates, neonatal outcome, arterial blood gas, electrolyte imbalance, mechanical ventilation, neonatal ICU*

Date of Submission: 21-01-2026 Date of Acceptance: 31-01-2026

I. Introduction

Mechanical ventilation remains a cornerstone of neonatal intensive care, providing vital respiratory support to critically ill newborns with respiratory failure and other systemic complications. Over the past decades, advances in ventilator technology, improved monitoring, and evidence-based neonatal care have significantly enhanced survival rates, particularly in high-income countries. However, in low- and middle-income settings such as Bangladesh, neonatal mortality among ventilated infants remains high due to late presentation, limited infrastructure, and inadequate biochemical and clinical monitoring (1,2). Respiratory failure is a common indication for mechanical ventilation in the neonatal intensive care unit (NICU). The major causes include respiratory distress syndrome (RDS), birth asphyxia, meconium aspiration syndrome, pneumonia, and sepsis (2,3). Despite advances in neonatal intensive care, mortality among mechanically ventilated neonates remains high. Studies from South Asia and Africa report 30–60 % mortality, with some critically ill cohorts exceeding 70 %(4,5). Understanding how various clinical and biochemical factors influence the prognosis of these critically ill neonates is therefore essential for improving outcomes and optimizing resource utilization. Several studies have demonstrated that biochemical and metabolic derangements play a pivotal role in determining neonatal survival. Abnormalities in arterial blood gas (ABG) parameters such as acidosis, hypercapnia, and hypoxemia reflect the

severity of respiratory and metabolic compromise and are strongly correlated with poor outcomes (6,7). Similarly, disturbances in serum electrolytes, blood urea, and creatinine levels are indicative of renal dysfunction and systemic involvement, which can complicate the course of mechanical ventilation(8,9). Neonates with significant hypoglycemia, hyponatremia, or hyperkalemia are particularly vulnerable, as these imbalances can precipitate cardiac arrhythmias, seizures, and multi-organ failure (10). Complications arising during ventilation such as pneumothorax, ventilator-associated pneumonia (VAP), pulmonary hemorrhage, and secondary sepsis, further worsen prognosis. The development of such complications is associated with a two- to threefold increase in mortality among ventilated neonates. Preventive strategies, including aseptic suctioning, careful ventilator management, and early extubation, have been shown to reduce the incidence of these complications and improve outcomes (11,12). While international studies have extensively examined the prognostic value of clinical and biochemical parameters, data from Bangladesh and similar low-resource settings remain limited. Local variations in perinatal care, infection control practices, and biochemical monitoring can influence survival patterns and make it important to identify context-specific predictors of outcome. The integration of ABG analysis and biochemical profiling into routine NICU monitoring may enable clinicians to identify high-risk neonates earlier and implement timely corrective measures, thereby reducing mortality. This study was therefore designed to bridge this knowledge gap by systematically evaluating the relationships between clinical characteristics, primary diagnoses, biochemical parameters, and complications during ventilation with the outcomes of ventilated neonates.

II. Methods

This prospective observational study was conducted in the Intensive Care Unit (ICU) of Dhaka Shishu Hospital, a tertiary care pediatric center, from June 2007 to March 2008. A total of 60 neonates requiring mechanical ventilation during this period were enrolled consecutively. Demographic and perinatal data including sex, gestational age, birth weight, and maturity status were recorded. Clinical diagnoses necessitating ventilation, such as birth asphyxia, neonatal sepsis, respiratory distress syndrome, meconium aspiration syndrome, pneumonia, and congenital heart disease, were documented. All neonates received intermittent positive pressure ventilation, and arterial blood gas (ABG) analysis was performed at initiation and as clinically indicated, recording pH, $PaCO_2$, PaO_2, bicarbonate, base excess, and oxygen saturation. Laboratory parameters including serum sodium, potassium, blood urea, creatinine, and random blood glucose were measured in the hospital laboratory. Complications during ventilation, such as pneumothorax, ventilator-associated pneumonia, pulmonary hemorrhage, and sepsis, were closely monitored. Neonatal outcomes were classified as improved (survived) or died (non-survivor). Data were analyzed using SPSS version 16.0, with continuous variables expressed as mean ± SD and categorical variables as frequency and percentage. Independent t-tests and chi-square tests were used for comparisons, with a p-value <0.05 considered statistically significant. The study was approved by the Ethical Review Committee of Dhaka Shishu Hospital, and informed consent was obtained from parents or guardians of all participants.

Inclusion Criteria

- Neonates (0–28 days) needing mechanical ventilation.
- Complete clinical and laboratory data available.

Exclusion Criteria

- Major lethal congenital anomalies.
- Transferred before outcome.
- Ventilated only postoperatively.

III. Results

Table 1: Baseline and Perinatal Characteristics Associated with Neonatal Outcome (N = 60)

Variable	Total (N=60)	Improved (n=23)	Died (n=37)	p-value
Sex				
Male	36 (60.0%)	14 (60.9%)	22 (59.5%)	0.915
Female	24 (40.0%)	9 (39.1%)	15 (40.5%)	
Gestational Age (weeks)	35.6 ± 4.31	36.4 ± 3.83	35.1 ± 4.57	0.312
Birth Weight (kg)	2.42 ± 0.74	2.59 ± 0.69	2.31 ± 0.76	0.187
Preterm (<37 weeks)	34 (56.7%)	11 (47.8%)	23 (62.2%)	0.276
Term (≥37 weeks)	26 (43.3%)	12 (52.2%)	14 (37.8%)	

Data presented as mean ± SD or n (%). Independent t-test and chi-square tests were used as appropriate.

As shown in Table 1, male neonates comprised 60% of the study population, with no significant sex difference between the improved and died groups (p=0.915). The mean gestational age was 35.6 ± 4.31 weeks, and the mean birth weight was 2.42 ± 0.74 kg. Neither gestational age nor birth weight showed a significant

association with outcome (p=0.312 and p=0.187, respectively). Preterm births were slightly more frequent among non-survivors (62.2%) compared to survivors (47.8%), though the difference was not statistically significant (p=0.276).

Table 2: Primary Clinical Diagnoses and Their Association with Outcome

Diagnosis / Indication for Ventilation	Total (N=60)	Improved (n=23)	Died (n=37)	p-value
Birth asphyxia	18 (30.0%)	8 (34.8%)	10 (27.0%)	0.530
Neonatal sepsis	14 (23.3%)	4 (17.4%)	10 (27.0%)	0.407
Respiratory distress syndrome (RDS)	9 (15.0%)	2 (8.7%)	7 (18.9%)	0.294
Meconium aspiration syndrome	7 (11.7%)	4 (17.4%)	3 (8.1%)	0.296
Pneumonia	5 (8.3%)	2 (8.7%)	3 (8.1%)	0.936
Congenital heart disease	4 (6.7%)	1 (4.3%)	3 (8.1%)	0.592
Others	3 (5.0%)	2 (8.7%)	1 (2.7%)	0.309

The most common indication for ventilation was birth asphyxia (30%), followed by neonatal sepsis (23.3%), and respiratory distress syndrome (15%) (Table 2). No specific diagnosis showed a statistically significant association with outcome (all $p > 0.05$).

Table 3: Arterial Blood Gas (ABG) Parameters and Their Relationship with Neonatal Outcome

Parameter	Improved (n=23, Mean ± SD)	Died (n=37, Mean ± SD)	p-value
pH	7.32 ± 0.07	7.19 ± 0.09	<0.001*
PCO_2 (mmHg)	41.2 ± 8.4	52.6 ± 9.7	<0.001*
PO_2 (mmHg)	67.5 ± 11.2	52.8 ± 10.6	<0.001*
HCO_3^- (mmol/L)	21.4 ± 3.2	17.9 ± 3.6	<0.001*
Base excess (mmol/L)	-3.8 ± 2.1	-7.4 ± 3.5	<0.001*
Oxygen saturation (%)	90.7 ± 4.6	80.9 ± 5.7	<0.001*

As shown in Table 3, all ABG parameters were significantly different between the improved and died groups ($p < 0.001$). Non-survivors had significantly lower pH (7.19 ± 0.09 vs 7.32 ± 0.07), lower PO_2, bicarbonate, and oxygen saturation, and higher PCO_2 and base deficit values. These findings indicate that severe metabolic and respiratory derangements were strongly associated with poor outcome.

Table 4: Biochemical and Electrolyte Factors Associated with Outcome

Parameter	Improved (Mean ± SD)	Died (Mean ± SD)	p-value
Serum sodium (mmol/L)	138.2 ± 3.8	134.6 ± 4.2	0.002*
Serum potassium (mmol/L)	4.1 ± 0.6	4.8 ± 0.8	0.001*
Random blood glucose (mg/dL)	87.3 ± 14.1	72.8 ± 18.3	0.001*
Blood urea (mg/dL)	34.5 ± 9.6	48.2 ± 13.7	<0.001*
Serum creatinine (mg/dL)	0.69 ± 0.15	0.91 ± 0.19	<0.001*

Non-survivors had significantly lower serum sodium and random blood glucose levels and higher serum potassium, blood urea, and creatinine levels compared to survivors (all $p < 0.01$) (Table 4). These biochemical abnormalities reflect significant metabolic disturbances and renal dysfunction among the neonates who died.

Table 5: Complications During Ventilation and Their Relationship with Outcome

Complication	Total (N=60)	Improved (n=23)	Died (n=37)	p-value
Pneumothorax	5 (8.3%)	1 (4.3%)	4 (10.8%)	0.379
Ventilator-associated pneumonia (VAP)	7 (11.7%)	2 (8.7%)	5 (13.5%)	0.580
Sepsis during ventilation	11 (18.3%)	2 (8.7%)	9 (24.3%)	0.126
Pulmonary hemorrhage	4 (6.7%)	0 (0.0%)	4 (10.8%)	0.112
No complication	33 (55.0%)	18 (78.3%)	15 (40.5%)	0.006*

In Table 5, complications were noted in 27 (45%) neonates. Pneumothorax, ventilator-associated pneumonia, and sepsis occurred more frequently among non-survivors, though these differences were not statistically significant. However, the absence of any complication was significantly associated with survival (78.3% vs 40.5%, p=0.006), suggesting that complication-free ventilation markedly improved outcomes.

IV. Discussion

This study investigated the association between clinical, biochemical, and ventilator-related factors and the outcomes of 60 ventilated neonates. Among these, 23 (38.3%) improved while 37 (61.7%) died, reflecting the critical condition of neonates requiring mechanical ventilation in resource-limited neonatal intensive care settings. In this study, male neonates (60%) were slightly more common; however, sex did not significantly influence survival ($p = 0.915$). The mean gestational age was 35.6 ± 4.31 weeks, and the mean birth weight was 2.42 ± 0.74

kg, neither of which significantly differed between survivors and non-survivors (p=0.312 and 0.187, respectively). Preterm infants (<37 weeks) made up 56.7% of the population, and although mortality was higher among preterm neonates (62.2%), the difference was not statistically significant. Similar findings were reported by Kumar et al. (2023) and Basu et al. (2008), who also observed a male predominance among ventilated neonates, but noted no sex-based survival difference (13,14). In contrast, Basu et al. (2008) reported a significantly higher mortality among very low birth weight neonates, reflecting the influence of extreme prematurity and limited pulmonary reserve (14). Therefore, in our cohort, gestational and birth-related factors appeared less predictive of outcome compared to metabolic and biochemical derangements. The most common indications for ventilation were birth asphyxia (30%), neonatal sepsis (23.3%), and respiratory distress syndrome (RDS) (15%). Although mortality was higher among neonates with sepsis (71%) and RDS (78%), none of the diagnostic groups showed a statistically significant association with survival (p>0.05). Similar diagnostic distributions have been reported by Riyas et al. (2003) and Moshiro et al. (2019), where perinatal asphyxia and sepsis were the leading causes of neonatal ventilation (15,16). Iqbal et al. (2015) also observed that outcomes in ventilated neonates were not primarily determined by diagnosis but by the timing and adequacy of intervention (2). Yehouala et al. (2024) reported a 42% survival among asphyxiated neonates, comparable to our 44% survival rate in birth asphyxia cases (17). Higher sepsis-related mortality in our study could be attributed to multidrug-resistant infections and late referral.Thus, while underlying diagnosis influences ventilation need, survival is more closely linked to the severity of systemic compromise. Arterial blood gas analysis showed strong associations between deranged parameters and mortality. Non-survivors had lower pH (7.19 vs. 7.32), higher PCO_2 (52.6 vs. 41.2 mmHg), lower PO_2 (52.8 vs. 67.5 mmHg), and greater base deficit (-7.4 vs. -3.8 mmol/L), all statistically significant (p<0.001). This indicates that both respiratory acidosis and hypoxemia strongly predicted poor outcomes. These findings align with Basu et al. (2015), who found that severe metabolic acidosis and hypoxemia independently predicted mortality among ventilated neonates(14). Brown et al. (2016) similarly reported that neonates with pH <7.2 or PO_2 <60 mmHg had over twice the risk of death (18). Furthermore, Iqbal et al. (2015) noted that persistent hypoxemia during ventilation was linked to adverse neurological sequelae and increased mortality (2). The current study thus reinforces that aggressive correction of acid-base and oxygenation abnormalities is critical for improving neonatal survival. Biochemical analysis revealed significant abnormalities among non-survivors. They had lower serum sodium (134.6 vs. 138.2 mmol/L) and random blood glucose (72.8 vs. 87.3 mg/dL), but higher potassium (4.8 vs. 4.1 mmol/L), urea (48.2 vs. 34.5 mg/dL), and creatinine (0.91 vs. 0.69 mg/dL). All differences were statistically significant (p<0.01). These findings are in line with Segar et al. (2021), who demonstrated that electrolyte disturbances, particularly hyponatremia and hyperkalemia, are common in critically ill neonates and strongly predict poor prognosis (19). Hypoglycemia observed in non-survivors corroborates the findings of Abramowski et al. (2023), where neonatal hypoglycemia at the onset of respiratory distress significantly increased mortality risk (20). The combination of electrolyte imbalance, renal dysfunction, and glucose instability likely reflects multiorgan involvement in critical illness. Hence, meticulous biochemical monitoring and correction are essential components of neonatal intensive care. During ventilation, 45% of neonates developed complications. Among these, pneumothorax occurred in 8.3%, VAP in 11.7%, and sepsis in 18.3%. The presence of any complication was significantly associated with death (p=0.006), although individual complications did not reach statistical significance. Similar complication rates were reported by Cernada et al. (2014), who observed a 43% overall complication rate among ventilated neonates and found that the presence of any ventilator-associated complication doubled the risk of death (21). Pulmonary hemorrhage, though less frequent in our study (6.7%), was fatal in all affected neonates, echoing the findings of Ferreira et al. (2014)(22). Our data reinforce that minimizing ventilator-related morbidity is crucial for improving survival.

Limitations of the Study:

This study was conducted in a single tertiary care center with a relatively small sample size, limiting the generalizability of the findings.

V. Conclusion

In ventilated neonates, acid-base imbalances, electrolyte disturbances, renal dysfunction, and ventilator-related complications significantly increase the risk of mortality. Baseline demographic factors and primary diagnoses were less predictive of outcome, highlighting the importance of dynamic monitoring and timely intervention during the course of mechanical ventilation.

VI. Recommendations

Neonatal intensive care should emphasize early detection and correction of ABG and biochemical abnormalities. Standardized protocols for ventilator management, complication prevention, and biochemical monitoring should be implemented. Future studies with larger cohorts and long-term follow-up are recommended

to develop risk stratification models that can guide clinical decision-making and improve neonatal survival in resource-limited settings.

References

[1]. Rocha G, Soares P, Gonçalves A, Silva AI, Almeida D, Figueiredo S, Et Al. Respiratory Care For The Ventilated Neonate. Can Respir J. 2018 Aug 13;2018:1–12.

[2]. Iqbal Q, Younus MM, Ahmed A, Ahmad I, Iqbal J, Charoo BA, Et Al. Neonatal Mechanical Ventilation: Indications And Outcome. Indian J Crit Care Med Peer-Rev Off Publ Indian Soc Crit Care Med. 2015;19(9):523.

[3]. Fernandes N, Chawla S. Mechanical Ventilation For Neonates. In: Sarnaik AP, Venkataraman ST, Kuch BA, Editors. Mechanical Ventilation In Neonates And Children [Internet]. Cham: Springer International Publishing; 2022 [Cited 2025 Oct 13]. P. 129–55. Available From: Https://Link.Springer.Com/10.1007/978-3-030-83738-9_8

[4]. Mokhtar Wesam, Kamal Naglaa, Sherief L, Kamel S. Mortality Risk In Mechanically Ventilated Neonates: A Developing Country Experience. Iran J Neonatol IJN [Internet]. 2021 Jan [Cited 2025 Oct 14];(Online First). Available From: Https://Doi.Org/10.22038/Ijn.2021.33734.1488

[5]. Tekulu TG, Lemma HH, Hadgu A, Gebrekidan G, Seyoum D, Hailu H, Et Al. Clinical Profile And Predictors Of Mortality Of Mechanically Ventilated Neonates In A Tertiary Hospital In Ethiopia. Discov Med. 2025 Sept 28;2(1):258.

[6]. Kumar D, Kumar D, Vinod S, Sharma IK, Yadav RK, Singh RB. Predictors Of Immediate Outcome In Neonates On Invasive Mechanical Ventilation. Iran J Neonatol. 2024 Oct 1;15(4):29–34.

[7]. (PDF) Predictors Of Mortality In Ventilated Neonates. Researchgate [Internet]. 2025 Aug 6 [Cited 2025 Oct 14]; Available From: Https://Www.Researchgate.Net/Publication/360868768_Predictors_Of_Mortality_In_Ventilated_Neonates

[8]. Akter J, Akter J. Integrative Analysis Of Hematological And Biochemical Markers Related To Ventilation Outcomes In Critically Ill Infants. The Insight. 2025 July 7;7(02):77–83.

[9]. Pradhan DD, Meher BK, Panda SK, Samal D. Prevalence And Factors Affecting Prognosis In Neonates With Acute Kidney Injury In A Neonatal Intensive Care Unit. J Clin Neonatol. 2018 Dec;7(4):237.

[10]. Sow NF, Sow A, Seck MA, Dieng YJ, Cissé DF, Faye PM, Et Al. Metabolic Emergencies In Newborns In A Subsaharian Neonatology Department: Evaluation Of Glucose, Sodium And Potassium Disorders. Open J Pediatr. 2022 Mar 28;12(1):263–73.

[11]. Azab SFA, Sherbiny HS, Saleh SH, Elsaeed WF, Elshafiey MM, Siam AG, Et Al. Reducing Ventilator-Associated Pneumonia In Neonatal Intensive Care Unit Using "VAP Prevention Bundle": A Cohort Study. BMC Infect Dis. 2015 Aug 6;15(1):314.

[12]. Thatrimontrichai A, Rujeerapaiboon N, Janjindamai W, Dissaneevate S, Maneenil G, Kritsaneepaiboon S, Et Al. Outcomes And Risk Factors Of Ventilator-Associated Pneumonia In Neonates. World J Pediatr WJP. 2017 Aug;13(4):328–34.

[13]. Kumar M, Swati Null, Biswas B, Kumar A, Kumari A, Kumar R. Pattern And Predictors Of Mortality Among Inborn And Out Born Neonates On Ventilatory Support: An Unmatched Case-Control Study. Am J Blood Res. 2023;13(2):71–6.

[14]. Basu S, Rathore P, Bhatia BD. Predictors Of Mortality In Very Low Birth Weight Neonates In India. Singapore Med J. 2008 July;49(7):556–60.

[15]. Riyas PK, Vijayakumar KM, Kulkarni ML. Neonatal Mechanical Ventilation. Indian J Pediatr. 2003 July;70(7):537–40.

[16]. Moshiro R, Mdoe P, Perlman JM. A Global View Of Neonatal Asphyxia And Resuscitation. Front Pediatr. 2019;7:489.

[17]. Yehouala SG, Tesfahun E, Dejene TM, Gebreegziabher ZA. Time To Recovery Of Asphyxiated Neonates And Its' Predictors Among Newborns Admitted To Neonatal Intensive Care Unit At Debre Berhan Comprehensive Specialized Hospital, Ethiopia. BMC Public Health. 2024 July 26;24(1):2006.

[18]. Brown MK, Poeltler DM, Hassen KO, Lazarus DV, Brown VK, Stout JJ, Et Al. Incidence Of Hypocapnia, Hypercapnia, And Acidosis And The Associated Risk Of Adverse Events In Preterm Neonates. Respir Care. 2018 Aug 1;63(8):943–9.

[19]. Segar JL, Chock VY, Harer MW, Selewski DT, Askenazi DJ, Guidelines NBS, Et Al. Fluid Management, Electrolytes Imbalance And Renal Management In Neonates With Neonatal Encephalopathy Treated With Hypothermia. In: Seminars In Fetal And Neonatal Medicine [Internet]. Elsevier; 2021 [Cited 2025 Oct 14]. P. 101261. Available From: Https://Www.Sciencedirect.Com/Science/Article/Pii/S1744165X2100069X

[20]. Abramowski A, Ward R, Hamdan AH. Neonatal Hypoglycemia. In: Statpearls [Internet]. Treasure Island (FL): Statpearls Publishing; 2025 [Cited 2025 Oct 14]. Available From: Http://Www.Ncbi.Nlm.Nih.Gov/Books/NBK537105/

[21]. Cernada M, Brugada M, Golombek S, Vento M. Ventilator-Associated Pneumonia In Neonatal Patients: An Update. Neonatology. 2014;105(2):98–107.

[22]. Ferreira CH, Carmona F, Martinez FE. Prevalence, Risk Factors And Outcomes Associated With Pulmonary Hemorrhage In Newborns. J Pediatr (Rio J). 2014;90(02):316–22.