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Exchange Transfusion: Experience of the Neonatal Intensive Care Unit in Morocco

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Abstract

This retrospective, single-center case series describes the clinical, laboratory, and outcome profiles of six neonates treated with exchange transfusion for severe unconjugated hyperbilirubinemia. Bilirubin levels decreased after treatment, thrombocytopenia occurred in four neonates, and neurological signs reportedly resolved in the two affected infants. Incomplete developmental and auditory follow-up limits conclusions about long-term benefit. This study was conducted after obtaining Free and informed parental consent was obtained for all patients.

Subject Areas

Pediatrics

Keywords

Exchange Transfusion, Neonatal Jaundice, Neonatal Intensive Care Unit, Morocco, Unconjugated Hyperbilirubinemia

1. Introduction

The neurotoxicity of unconjugated hyperbilirubinemia remains a formidable challenge in neonatology. It occurs when total bilirubin levels exceed neuroprotective defense thresholds [1], triggering a cascade of inflammatory reactions leading to brain injury, which manifests as acute bilirubin encephalopathy or, if irreversible, chronic bilirubin encephalopathy.

Chronic bilirubin encephalopathy occurs in 20% of neonates with total serum bilirubin levels exceeding 300 mg/L [2]. This complication remains preventable through the use of phototherapy, intravenous immunoglobulin (IVIG) therapy, or exchange transfusion (ET), all of which serve to reduce serum bilirubin levels [3].

Exchange transfusion remains the most effective therapeutic option for rapidly lowering blood bilirubin concentrations [4]. It aims to simultaneously eliminate a significant proportion of unconjugated bilirubin, pathological red blood cells or those coated with maternal antibodies, as well as circulating antibodies in cases of fetomaternal incompatibility.

2. Patients and Methods

This was a retrospective descriptive case series conducted in the Neonatal Intensive Care Unit (NICU) of the Hassan II Regional Hospital Center (CHR) in Agadir, Morocco, over a one-year period from September 2024 to September 2025.

Data were collected from physical medical records and admission registers retrieved from the department's archives.

All consecutive neonates admitted during the study period for unconjugated hyperbilirubinemia who underwent exchange transfusion were comprehensively included. The indication for exchange transfusion was established based on the therapeutic threshold curves recommended by the French Society of Neonatology (SFN). Neonates with unusable medical records or major missing clinical and laboratory data were excluded from the study. Overall, six consecutive cases met these eligibility criteria and were included for analysis.

3. Results

During the study period, 230 neonates were admitted for neonatal jaundice, of whom only six underwent exchange transfusion (ET). Among them, five were term neonates and one was late preterm at 36 weeks of gestation, with a mean birth weight of 3.0 kg.

Male sex predominated, with a male-to-female ratio of 2:1. Vaginal delivery was the most common mode of delivery, accounting for 83.3% of cases (n = 5). Maternal age ranged from 27 to 35 years, with a mean of 30 years.

Age at presentation ranged from 8 to 102 hours of life. Clinical features of acute bilirubin encephalopathy were documented in two neonates, manifesting as seizures and oculogyric crises.

At admission, total serum bilirubin (TSB) levels ranged from 255 to 320 mg/L [25.5 - 32.0 mg/dL]. Routine post-procedure laboratory testing performed 8 hours after exchange transfusion demonstrated marked improvement, with levels decreasing to between 130 and 174 mg/L [13.0 - 17.4 mg/dL] (See **Table 1**).

The leading etiology was Rhesus (Rh) isoimmunization in four cases, followed by ABO incompatibility in two neonates.

All patients were initially started on continuous intensive phototherapy. Double-volume exchange transfusion was performed emergently upon admission for the two neonates presenting with neurological manifestations, and within the first 24 hours of hospitalization for the remaining patients once TSB levels were plotted on the therapeutic threshold curves following the French Society of Neonatology (SFN) protocol. The total volume exchanged ranged from 140 to 180 mL/kg, with

a mean procedure duration of 2 hours.

In addition to repeat bilirubin measurement, a complete blood count (CBC) and serum electrolyte panel were systematically obtained at 8 hours post-exchange transfusion. Regarding procedure-related adverse events, thrombocytopenia was identified in four neonates (66.7%), with platelet counts ranging from 69,000 to 98,000/mm^3, which resolved spontaneously within 72 hours post-procedure. A single neonate developed ionized hypocalcemia (68 mg/L) requiring intravenous correction.

All patients received clinical follow-up up to 3 months of age before being referred to local community hospitals for continuing care. The clinical course was marked by the progressive resolution of neurological signs with age-appropriate psychomotor development. Brain magnetic resonance imaging (MRI) was performed in two neonates during the third week of life and revealed no abnormalities. To date, none of the patients have undergone hearing screening.

Table 1. Characteristics of the neonates.

Case	Postnatal age at admission (hours)	Maternal Age	Gestational Age	Incompatibility	Bilirubin pre-ET (mg/L)	Bilirubin post-ET (mg/L)	Neurological Signs
1	52H	28 years	37	Rhesus	316	130	None
2	74H	35 years	38 + 5d	O/A	320	174	None
3	102H	35 years	36	Rhesus	285	152	Seizures, High-pitched cry
4	12H	25 years	39	Rhesus	267	136	None
5	48H	34 years	39	O/B	305	121	Hypotonia, Oculogyric crises
6	8H	28 years	37 + 5d	Rhesus	255	155	None

4. Discussion

Unconjugated hyperbilirubinemia affects the majority of term and preterm neonates [5]. While often benign and transient, it can become complicated and induce neurotoxic injury.

Regarding the etiologies of hyperbilirubinemia leading to Exchange Transfusion (ET), many studies have reported that Rhesus and ABO incompatibilities are the leading causes, followed by hemolysis due to G6PD deficiency [5] [6].

In our context, the sole criterion for indicating ET was the serum bilirubin threshold plotted on therapeutic indication curves, based on the french protocol [7] and following the recommendations of the French Society of Neonatology. Other studies indicate ET in the presence of neurological signs of bilirubin encephalopathy [8]; this is a rational and urgent indication, especially since neurological impairment may be reversible or mitigated if ET is rapidly implemented to improve the patient's neurological prognosis [9], as was the case for two neonates in our study.

Regarding the total exchange volume, it is recommended to exchange 140 mL

to 160 mL/kg to ensure ET efficacy. Furthermore, the aliquots (volumes withdrawn or injected) must not exceed 5 mL/kg to ensure good hemodynamic tolerance and avoid ET-related complications [10].

Beyond their potential benefit in reducing the need for exchange transfusion [11], albumin and intravenous immunoglobulin (IVIG) infusions may be considered while awaiting an ET in clinical situations with a high risk of bilirubin neurotoxicity [12]. However, none of our patients received these treatments due to their unavailability during the study period. Furthermore, the American Academy of Pediatrics (AAP) explicitly emphasizes that the efficacy of IVIG in preventing exchange transfusion remains uncertain; its use is reserved strictly for neonates with confirmed isoimmune hemolytic disease (positive direct antiglobulin) reaching the escalation of care threshold specifically, when total serum bilirubin is within 2 mg/dL of the exchange transfusion threshold or is rapidly rising despite intensive phototherapy [13].

Beyond frequent complications, notably thrombocytopenia, hypocalcemia, and metabolic acidosis, ET may also be complicated by hyperkalemia, hypoglycemia, and hemodynamic instability [14]. In the long term, jaundiced neonates may present with irreversible hearing impairments; studies have shown that the risk of auditory neuropathy is higher when total bilirubin levels exceed 200 mg/L [15]. Other studies report risks of speech and language disorders, motor disorders such as extrapyramidal syndrome, choreic movements or dystonia, and oculomotor paralysis due to damage to the basal ganglia and brainstem nuclei [16]. Hence the importance of long-term follow-up in these patients.

5. Conclusion

In conclusion, this study highlights our experience with exchange transfusion and demonstrates its benefit, in combination with phototherapy, in rapidly reducing serum bilirubin levels and achieving the resolution of neurological signs in affected neonates. However, our study was limited by the lack of long-term auditory and psychomotor follow-up. Future studies should involve larger sample sizes and systematically incorporate neonatal hearing screening and structured auditory assessments.

Author Contributions

All authors critically reviewed, read, and approved the final version of the manuscript.

Conflicts of Interest

The authors declare no conflicts of interest.

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