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# Fellows Column: Serial Direct Bilirubin Measurement in the Management of Neonatal Hyperbilirubinemia: A System Error

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**Case Presentation:**

A female infant was born at term via vaginal delivery. The infant was transferred to the newborn nursery. Bilirubin collected at 12 hours of life was 10 mg/dL. The mother's blood group was A positive, and the baby was AB positive with Coombs positive. Phototherapy was started based on the clinical pathway/guideline nomogram. (1) Serial bilirubin levels were followed, and phototherapy was discontinued once the level was below the threshold for treatment. The infant was discharged home with a follow-up in 48 hours.

**System and Process Error:**

During the case audit, a system error was detected. In addition to the serial indirect bilirubin, we noted that 11 specimens of direct (conjugated) bilirubin were obtained during the treatment (Table 1, Figure 1). Applying the five whys principle (2), we found measuring of the direct bilirubin as an ongoing practice in the nursery established by the retired physician (1st why - the on-call intern ordered it because the day intern ordered it, 2nd why - the day intern ordered it because the senior resident ordered it, 3rd why - the senior resident ordered it because the nurse practitioner (NP) ordered it, 4th why- the NP ordered it because she observed the retiring physician ordering it).

**Heuristics and Biases:**

In daily life, we encounter cognitive bias and heuristics in decision-making. (3) These biases could take the form of anchoring bias (tendency to adjust toward the first piece of information), availability bias (tendency by which a person evaluates the probability of events by the ease with which relevant instances come to mind), and confirmation bias (tendency to search for, to interpret, to favor, and to recall information that confirms or supports one's prior personal beliefs). (4) These factors could have played a role among the trainee interns and residents to keep ordering serum direct bilirubin levels without questioning the value in managing hyperbilirubinemia.

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**Bound by Investigation:**

The plausible reasons for obtaining direct (conjugated) bilirubin in a newborn infant are to diagnose biliary atresia and prevent bronze baby syndrome (BBS) if prolonged phototherapy is provided. (5,6) Although BBS is a potential complication of using phototherapy with direct bilirubinemia, phototherapy-induced bronzing is a self-limited process. It should not prevent the use of phototherapy for hyperbilirubinemia in infants with elevated levels of conjugated bilirubin, as suggested by Le and Reese. (5) A recent study of 124 385 infants using conjugated bilirubin identified seven infants with biliary atresia with a sensitivity of 100% and a specificity of 99.9%. However, the authors concluded that research is needed in larger populations to precisely estimate this screening approach's diagnostic yield and cost-effectiveness. (6)

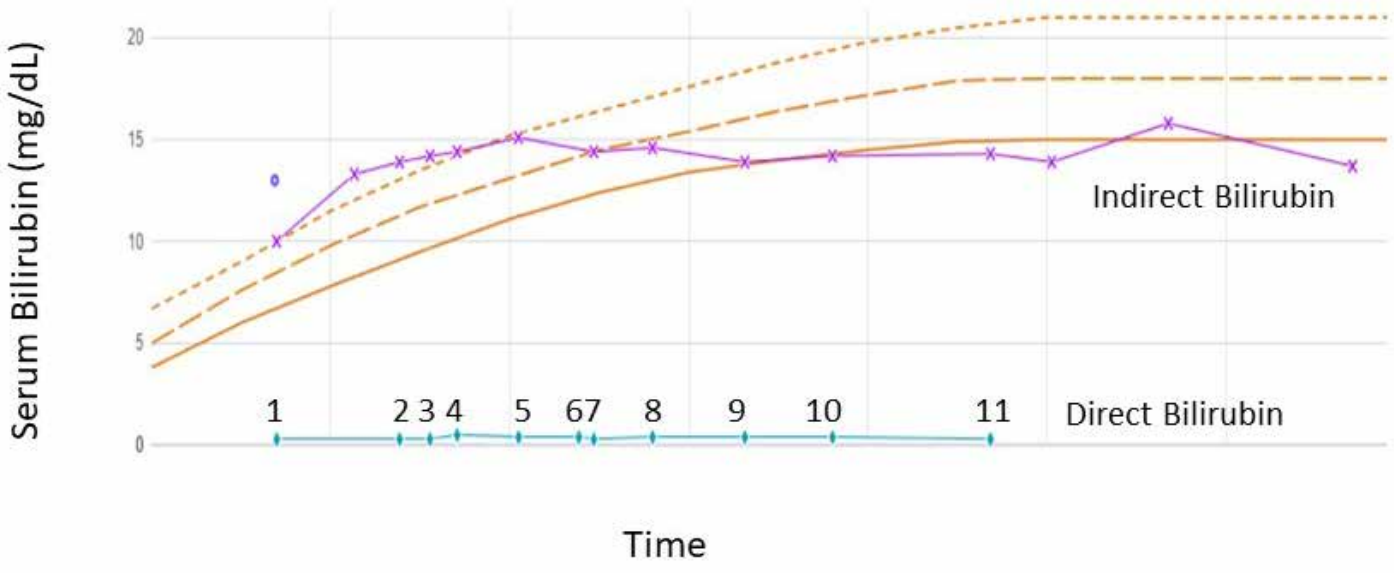


*Figure 1 Graph showing serial serum bilirubin levels*

| Date | Time | Bilirubin |
|---|---|---|
| Day 2 | 05:30 | 0.3 |
| Day 2 | 21:59 | 0.3 |
| Day 3 | 02:03 | 0.3 |
| Day 3 | 05:41 | 0.5 |
| Day 3 | 13:55 | 0.4 |
| Day 3 | 22:00 | 0.4 |
| Day 4 | 02:05 | 0.3 |
| Day 4 | 07:53 | 0.4 |
| Day 4 | 20:15 | 0.4 |
| Day 5 | 08:00 | 0.4 |
| Day 6 | 05:10 | 0.3 |

*Table 1: Serial Direct Bilirubin Level (mg/dl)*

**Choose Wisely Initiative:**

The process error noted was viewed as low-value care (we did not conduct any survey to look at the national practice). The pediatric residents in training need to be cognizant of the laboratory tests and treatment. Choosing Wisely Top Five for newborn medicine highlights five tests and treatments that cannot be adequately justified based on efficacy, safety, or cost. (7) These include (1) avoiding routine use of antireflux medications for the treatment of symptomatic gastroesophageal reflux disease or treatment of apnea and desaturation in preterm infants, (2) avoiding a routine continuation of antibiotic therapy beyond 48 hours for initially asymptomatic infants without evidence of bacterial infection, (3) avoiding the routine use of pneumograms for predischarge assessment of ongoing and/or prolonged apnea of prematurity, (4) avoiding routine daily chest radiographs without an indication for intubated infants, and (5) avoid routine screening term-equivalent or discharge brain MRIs in preterm infants. Measurement of serial conjugated bilirubin could be another one.

**Extra Cost:**

The extra cost for the direct bilirubin was $77 (11 specimens drawn). Our institution charges $7 for measurement of direct bilirubin (https://www.ochsnerlsuhs.org/patients-visitors/billing-financial-services/billing-estimates). McClean et al. (8 )had shown cost savings and reduced painful heel sticks using transcutaneous bilirubinometry at the community level.

***"This case serves as an important reminder that a careful approach to the blood draws should be followed in neonates. Although it is important to rule out cholestasis in neonates receiving phototherapy, it is crucial to remember the key tenet of doing no harm. The unnecessary, extensive workup and burden of painful procedures create a cascade effect."***

**Lessons Learned:**

This case serves as an important reminder that a careful approach to the blood draws should be followed in neonates. Although it is important to rule out cholestasis in neonates receiving phototherapy, it is crucial to remember the key tenet of doing no harm. The unnecessary, extensive workup and burden of painful procedures create a cascade effect.

Additionally, residents in training need to be mindful of this cascade to avoid anchoring and pursuing unnecessary workups. The initiative should be taken to decrease laboratory testing in neonates. Klunk et al. (9) analyzed the problem of laboratory investigation among neonates, and by applying the Pareto principle, they found bilirubin to be the third most common laboratory investigation. They suggested adherence to guidelines and compliance as major factors in reducing the laboratory investigation.

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