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# **Diagnostic Value of Ultrasound Parameter in Neonatal Biliary Atresia Based on Histopathological Results (Ultrasound study of triangular cord sign and gallbladder abnormality)**

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## **ABSTRACT**

**Objective:** Biliary atresia is an obliterative progressive disease that forms fibrotic tissue in the biliary tract in the neonatal phase. In some European countries, the reported incidence of biliary atresia varies between 1/14,000 and 1/20,000 live births. Ultrasound examination is the modality used to diagnose Biliary Atresia. Ultrasound assessed the sensitivity, specificity, and accuracy of the Triangular Cord Sign and gallbladder abnormality consisting of gallbladder contractility and wall echogenicity. We evaluated the diagnostic test results of Triangular Cord Sign and gallbladder contractility and wall echogenicity with ultrasound examination based on histopathological results of neonatal biliary atresia

**Material and Methods:** This diagnostic test was performed retrospectively between January 2019 and December 2020 with consecutive sampling techniques. A total of 61 pediatric patients clinically diagnosed with biliary atresia underwent ultrasound examination of triangular cord sign and gall bladder abnormality examined by a pediatric radiologist. Histopathological results of liver biopsy specimens confirming biliary atresia were available for all those patients. Data were analysed to assess accuracy, sensitivity, specificity, PPV, and NPV of ultrasound compared with histopathology result

**Result:** The Triangular Cord Sign sensitivity was found to be 70%, specificity 18.2%, PPV 79.5%, NPV 11.8%, and accuracy 60.7%. There was a significant relationship between Triangular Cord signs and histopathology. Gallbladder contractility parameter sensitivity was 76. %, specificity 18.2%, PPV 80.9%, NPV 14.3%, and accuracy 65.6%. However, there was no significant relationship between the histopathology results and the gallbladder wall's echogenicity, with a sensitivity of 70%, specificity of 18.2%, PPV of 79.5%, NPV of 11.8%, and accuracy of 60.7%.

**Conclusion:** The appearance of the triangular cord sign on ultrasonography has a significant relationship with the results of histopathology in biliary atresia

**Keywords:** Biliary atresia, Triangular Cord Sign, Gallbladder Contractility, Gallbladder wall echogenicity.

## **1. Introduction**

Biliary atresia refers to a progressive obstruction due to fibrotic tissue formation within the biliary tract, occurring as early as the neonatal and prenatal stages. It represents biliary system obliteration and separation, entailing the disruption of the bile secretion. Constituting a significant proportion of more than 90% of all cholestasis, biliary atresia must be promptly managed surgically to prevent the occurrence of the secondary biliary (Choi et al., 1996).

In some European countries, the reported biliary atresia incidence varies between 1/14,000 and 1/20,000 live births. Meanwhile, the Pacific Ocean region reported a substantially higher incidence of 1/2,400 live births for unknown reasons. This phenomenon has been studied, focusing on the period and distribution of biliary atresia incidence; however, a broader scope of the investigation is yet to be commenced (Wildhaber, 2012). In Indonesia, epidemiological data on biliary atresia is still lacking; nevertheless, a notable study has been conducted at Cipto Mangunkusumo Hospital, Jakarta, reported 60 biliary atresia patients in total, with only around 20% seeking treatment before two months of age (Waiman E., 2016).

## **2. Materials and Methods**

### **2.1 Study Design**

This is a retrospective, analytical observational study with a cross-sectional design conducted at Dr Soetomo General Academic Hospital Surabaya.

### **2.2 Ethical Clearance**

This study has met the Ethics Committee approval of Dr Soetomo General Academic Hospital, Surabaya. All participants included in the project had given their written informed consent to participate.

### **2.3 Subjects**

The sample consisted of 61 patients clinically diagnosed with biliary atresia than radiographic ultrasonography examination in the Radiology Department of Soetomo General Academic Hospital Surabaya. The inclusion criteria were neonates diagnosed with suspected biliary atresia based on the patient's clinical and laboratory results. Patients who failed to present at the time of examination were excluded.

### **2.4 Ultrasonographic examination**

A thicker triangular cord sign of more than four millimetres has approximately 80% sensitivity and around 89% specificity in cholestatic neonatal jaundice, with a 94% positive predictive rate in diagnosing biliary atresia. The triangular cord in the US examination appears to contain a cystic or hypoechoic mass in the linear, tubular, or round shape, confirmed in the histopathology investigation as a cleft-shaped cystic lesion and as a high signal intensity triangular area in the T2 sequence in MRCP (Lee et al., 2003).

The four classifications of biliary atresia can be described as follows: (1) undetected gallbladder (type 1), (2) existing gallbladder with hyperechoic and even mucosal layer and thickened walls without lumen, or partially patent lumen (type 2), (3) filled lumen with a length of 1,5 cm or less, with no thickened wall (type 3), and (4) filled lumen measuring more than 1,5 cm with no thickened wall. The length of the lumen should be measured carefully if the gallbladder is visible to be assigned to the classification. The gallbladder wall is said to be thickened when the hypoechoic layer is sandwiched between hyperechoic layers. In type 4, the length-to-width ratio of the lumen must be calculated by estimating the greatest length and inner walls' widest distance (Farrant P, Meire HB, 2000).

### **3. Result**

Our study involved 61 infants with ultrasonography and histopathology of liver biopsy ready for analysis, with an age average of 12 months old (SD = 17,4). Ultrasonographic TACS was identified in 44 samples, and the biliary atresia diagnosis was concluded from the histopathological result; however, false positives were found in four patients (table 1), resulting in a sensitivity value of 88%, specificity of 63,6%, positive predictive value of 91,7% and negative predictive value of 53,8%, with an accuracy rate reaching 83,6%. The Fisher's exact test was utilised to assess the statistical significance and demonstrated a significant relationship between the triangular cord finding and the histopathological results ( $p < 0.05$ ).

We found 44 out of 61 patients having positive gallbladder wall echogenicity along with confirming histopathology result of biliary atresia diagnosis (72,1%) (table 2), yielding a sensitivity of 70%, specificity of 18,2%, PPV of 79,5%, and NPV of 11,8%, with an accuracy of approximately 60,7%. Significance test using Fisher's exact test resulted in a non-significant association between gallbladder wall echogenicity and histopathology results ( $p > 0.05$ ). Similarly, the gallbladder contractility parameter was found to have no significant relationship with the histopathology examination ( $p > 0.05$ ), as only 47 samples featured the contracted gallbladder having established histopathology report (77%), with a sensitivity of 76%, specificity of 18,2%, PPV of 80,5%, NPV of 14,3%, and accuracy of 65,6%.

#### 4 Discussion

Based on gender, more male patients were found (54,1%) than female patients, while the highest age group was in the age range of 10,25 months with an average age of 12 months. Research on biliary atresia by So Mi Lee et al. discovered a comparable ratio between men and women with 51% and 49%, respectively, with an age average of 3 - 129 days. Also, the study sample by Kanegawa et al. consisted of 53% men and 47% women with an age average of 8 - 144 days (Kim WS et al., 2007).

The TC sign was evident in 48 patients (78,8%) with confirmatory histopathology result, estimating a sensitivity value of 88%, specificity of 63,6%, PPV of 91,7%, and NPV of 53,8% with an 83,6% accuracy. However, these figures were reasonably lower than those of Kanegawa et al., who obtained sensitivity and specificity values of 93% and 96%, discretely, with 95% accuracy (Kim WS et al., 2007).

Moreover, our findings on the picture of gallbladder wall echogenicity were slightly lower in sensitivity and specificity values compared to the previous study, with a plunging figure on accuracy. An investigation by Seerat Aziz et al. yielded a sensitivity value of 80% and specificity of 21% with 90% accuracy (Kim WS et al., 2007). Likewise, the gallbladder contractility parameter in our results was also inferior to the findings of the prior study by Kanegawa et al., who saw a sensitivity value of 86% and specificity of 25% with 95% accuracy (Kim WS et al., 2007).

#### 5. Conclusion

The number of patients with triangular cord sign with biliary atresia with confirmed histopathology results 44 of 61 patients ( $p < 0.05$ ), sensitivity value 88%, specificity 63.6%, PPV 91.7%, NPV 53.8% and accuracy 83 ,6%.

The number of patients with gall bladder wall echogenicity with biliary atresia confirmed by histopathology 35 patients from 61 patients ( $p > 0.05$ ), sensitivity value 70%, specificity 18.2%, PPV 79.5%, NPV 11.8% and accuracy 60.7%

The number of patients with confirmed Gall bladder Contractility with Biliary Atresia, 38 patients from 61 patients ( $p > 0.05$ ), Sensitivity value 76%, Specificity 18.2%, PPV 80.9%, NPV 14.3% and Accuracy 65 ,6%

In conclusion, our study has proven a significant relationship between the triangular cord sign and biliary atresia diagnosis, according to the previous findings from various authors. However, we did not establish any significant association between the gallbladder wall



echogenicity and contractility with the diagnosis based on the histopathological examination. Nonetheless, these results may foster further studies regarding biliary atresia in our centre for the purpose of improving the accessibility of early detection and management. We also encourage the advancement of similar investigations in a broader scope to gain a better and more reliable outcome.

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### **Conflict of Interest**

The authors declared no conflict of interest that might influence the outcome of this study.

### **Abbreviations :**

TACS: Triangular Cord Sign

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