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Research Article

The Prevalence of Hjortsjo Crook Sign of Right Posterior Sectional Bile Duct and Bile Duct Anatomy in ERCP of 237 Patients

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Abstract

Aim: Knowledge of the implication of positive sign can facilitate safe resection for both bile duct and portal vein and aid in the donor selection for live donor liver transplant. The frequency of the Right Posterior Sectional Bile Duct (RPSBD) hump sign in cholangiogram when it cross over the right portal vein known as Hjortsjo Crook sign and the bile duct anatomy is studied.

Methods: prospectively we included 237 patients with indicated ERCP during a period from March 2010 to January 2015.

Results: the mean age (±SD) and male to female ratio for 199 Saudi and 38 non-Saudi patients were: 37.8 (±20.01) vs 45.3 (±15.48) and 1: 1.37 vs 1: 0.9 respectively. No significant difference detected in positive Hjortsjo Crook sign between Saudi and non-Saudi patients, which was 18% (36) vs 21% (8) respectively. The sign found to be equally more frequent in Nakamura's RPSBD anatomical variant type I and Type II in both Saudi and non-Saudi patients, in 8% (16) vs. 10.5% (4) and 6.5% (13) vs. 7.9% (3) respectively.

Conclusion: Hjortsjo Crook sign frequently present in RPSBD variation type I & II in our patients.

Introduction

The anatomy of the bile duct (BD) is resembling that of the portal system and liver segments. Based on the literature, the proportion of biliary anatomical variations varies between 28% and 43%. Most of hilar bile ducts anatomical variations stem from different Right Posterior Sectional Bile Duct (RPSBD) origin [1,2].

Shimizu's operative series showed that the RPSBD is most commonly supraportal in 84%, infraportal in 13% and rarely combination in 3% (the segment VII duct supraportal and segment VI infraportal) [3]. Furthermore, Nakamura's operative series report the supraportal RPSBD to be most common in BD variant type I (65%, the classic form where the RPSBD and the anterior sectional BD join to form a single right hepatic duct), type II (9.2%, the RPSBD joins the confluence, forming trifurcation) and type IV (15.8%, the RPSBD joins the left hepatic duct), whereas, the infraportal RPSBD as type III (8.3%) and the combination as type V (1.7%) [4]. Recognition of the hump appearance in animal cholangiogram to be due to supraportal upward course of the RPSBD was first by Hjortsjo Crooks in 1951 [5]. The sign can be positive for the supraportal type BD the classic Nakamura type I, II or type IV. Recognition of the Hjortsjo's Crook sign (HCS) in ERCP can enrich our preoperative knowledge of biliary anatomical variation, their precise delineation and anticipation for technical modifications to achieve safe curative liver resection [3], transplantation [4, 6-8] and to avoid biliary injury in common general surgical

procedure like cholecystectomy [9-11].

Our study describes the characteristics of HCS of the RPS-BD anatomy in relation to the right portal vein (RPV) among Saudi population using ERCP cholangiogram. To date, the relation of the different anatomical variation of the RPSBD to the RPV based on HCS never been examined before in human.

Materials and Methods

Patients and methods

This prospective study carried out during the period from March 2010 to January 2015. We prospectively included 237 consecutive patients undergone ERCPs full filling the inclusion criteria with age range 18-90 years old. Relevant demographic and laboratory data obtained and depicted in Table 1 and 2. Patients with complete imaging study and without any prior history of liver resection or biliary instrumentation were considered as inclusion criteria, while criteria like, incomplete study, previous liver surgery and previous liver transplantation were considered as exclusion criteria. The ERCP cholangiogram was reviewed by two radiologists separately. Further filling and focused image in ERCP done if needed during the procedure. The anatomy is interpreted by two different radiologists.

	Saudi	Non-Saudi	P value
	N = 199	N= 38	
Age:			
- Mean (SD)	37.8	45.3	0.04
	-20.01	-15.48	
Median (range)	33.033	43	
	(18-97)	(18-72)	
Gender			
Male	84	20	0.34
Female	115	18	0.24
M: F ratio	01:01.4	01:00.9	
Total:	199	38	
N: number			

Table 1: Patient Demography.

This research is supported by the University of Imam Abdulrahman bin Faisal (formerly known as University of Dammam) (institutional Research Board: 201054), accordingly, the ethics approval obtained and Informed consent was weaved.

Statistical analysis

Data analyses included descriptive statistics computed for continuous variables, including means, Standard Deviations (SD), minimum and maximum values as well as 95% CI. Frequencies were used for categorical variables. In this study, no attempt at imputation for missing data. For all tests, significance is defined as $p<0.05$ (95% confidence interval). All statistical analyses done using SPSS 12 (Chicago, Illinois, USA).

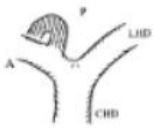
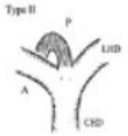
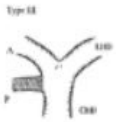
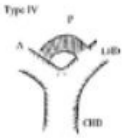
Result

The patient's demography data shown in Table 1. There were significant differences between the two groups in term of age but not gender at the time of ERCP. Likewise, minor laboratory difference between the two groups but not clinical difference in all biochemical profiles between Saudi and Non-Saudi population as depicted in Table 2.

Variables	Normal ranges	Saudi	Non-Saudi	*P* value
		Mean ± SD	Mean ± SD	
T Bili	(0.1-1.0)	8.7655 ± 21.78339	6.1267 ± 9.01328	0.0001
D Bili	0.0 – 0.4	6.9978 ± 17.24988	3.9726 ± 7.77706	0.0004
Alkaline Phosphatase	50 - 140	254.0222 ± 224.22206	281.6667 ± 261.21256	0.24
PT	14-Nov	12.6705 ± 2.45859	13.1333 ± 2.29833	0.66
GGTP	May-85	269.8923 ± 325.76886	450.7500 ± 640.03690	0.0001
Albumin	3.5 – 4.8	3.7143 ± 3.64814	3.1043 ± 0.66434	0.46
WBC	11-Apr	8.4414 ± 3.75207	9.0738 ± 6.69831	0.0002
Platelet	140 - 440	285.0127± 138.17845	278.2188 ± 103.48998	0.041
Amylase	25 - 125	218.7683 ± 484.17567	132.4500 ± 230.60800	0.0001
Lipase	24-Apr	1348.9000 ± 4559.71331	1918.6875± 5160.31947	0.33
T Bili: Total Bilirubin, D Bili: Direct Bilirubin, PT: Prothrombin Time				

Table 2: Biochemical Determination. Comparative evaluation of biochemical profile.

Most patients in both groups were diagnosed with typical anatomical BD variant type 1. While type II RPSBD anomaly is the second commonest anomalies in both groups was also detected in 18.1% of Saudi patients and 15.8% of non-Saudi patients with no significant difference. (Table 3).

	Saudi (N =199)			**Non – Saudi (N =38)**			***P* value**
RPSBD^ Anatomical Variant §	Positive HCS N (%)	Negative HCS N (%)	Total	Positive HCS N (%)	Negative HCS N (%)	Total	
	16 (8.0)	103 (51.8)	**119 (59.8)**	4 (10.5)	22 (58)	**26 (68.5)**	**0.49****
	13 (6.5)	23 (11.6)	**36 (18.1)**	3 (7.9)	3 (7.9)	**6 (15.8)**	**0.74****
	0	5 (2.5)	**5 (2.5)**	0	3 (7.9)	**3 (7.9)**	**0.99***
	4 (2)	32 (16.1)	**36 (18.1)**	1 (2.6)	1 (2.6)	**2 (5.2)**	**0.99***
Type V Mixed type	0	0	**0**	0	0	**0**	
Un-determined	1 (0.5)	2 (1.0)	**3 (1.5)**	0	1 (2.6)	**1 (2.6)**	**0.99***
Total	**36 (18)**	**163(82)**		**8 (21)**	**30 (79)**		**0.67****

^RPSBD: Right Posterior Sectional Bile Duct. § Nakamura's classifies RPSBD, N: number. HCS: Hjortsjo Crook sign, Data are frequency counts (percentage of total).
* = Fisher exact test, **= Chi square test

Table 3: Comparative evaluation of different types of Hjortsjo Crook Sign.

Positive HCS was detected more frequently among patients with Type I RPSBD anatomy in both Saudi and non-Saudi, 16 (8%) and 4 (10.5) respectively. The second commonest occurrence of positive HCS in Saudi were found in type II RPSBD variant, in 13 (6.5%) patients. On the other hand, only 2 (1.5%) Saudi and 1 (2.6%) non-Saudi patients were detected with type-III had positive HCS. The presence of positive of HCS in both groups depicted in table 3. Clearly showed the difference between the two groups is not significant.

Discussion

Knowledge of details hepatobiliary anatomy is vital while performing complex surgical procedures such as liver transplant or hepatobiliary surgeries. This is particularly important especially when it comes to anatomic areas with high rates of variations. Multiple biliary orifices in hilar transection plane requiring complex reconstruction are as common as 26% in Ohkubo's and 39.6% in Kasahara's operative series, requiring hilar dissection [1,6]. Hence, the extensive pre-operative imaging studies to determine the bile ducat anatomical variant is of paramount.

In typical biliary duct course, the lateral hepatic bile duct supplying segments VI and VII and the paramedian hepatic bile duct supplying segments V and VIII re-unite to form the Right Hepatic Bile Duct (RHD). However, it has been reported that only 57% cases are found to be associated with this kind of modal disposition [12]. Many anatomic variations of the convergence of biliary ducts are reported, where the RHD may join the main hepatic duct below the normal confluence level (anterior region in 9% cases and posterior region in 16 % cases). However, there are situations where the right anterior and posterior segmental bile ducts do not form the right hepatic duct and 6% to 9% of the cases the right anterior segmental duct joins the left hepatic duct while in 7% to 14% of the cases the anterior segmental duct joins the hilar confluence and forms and three-branch type hilar confluence (c), similarly 9% to 27% cases, the posterior segmental duct joins the left hepatic duct [12-14].

To determine the specific anatomical variations, various studies have been conducted using different modalities like cadaveric research [15], intraoperative cholangiogram [16,17] or imaging such as ultrasonography [18] and magnetic resonance cholangiography [19,20]. On the other hand, ERCP is the standard technique in this field, provides if done properly, a detailed anatomy of the extrahepatic and the intrahepatic biliary anatomy as well [21]. The ERCP procedure was used in this study to document the variant biliary anatomy and the RPSBD and to investigate the usefulness of positive HCS in delineation patterns of the RPSBD in relation to right postal vein as demonstrated in cholangiogram obtained through ERCP.

Due to expansion and advancement in surgical intervention in hepatobiliary conditions and transplant this area has moved from anatomy books and being an area of clinical research to practical needs [22]. Previous studies dealt with patients from the West or the Far East area and have reported anatomic variants of hepatobiliary system detected by intraoperative cholangiography, MRCP (magnetic resonance cholangiography), or ERCP [23-26]. To our knowledge, this is the first study to examine the relationship between HCS and the various patterns of the RPSBD variable anatomy in human. We looked at the delineation patterns of the RPSBD in relation to the HCS in patients with hilar images in ERCP applied on 237 consecutive patients and in relation to Hjortsjo crook sign presence and this can be taken to represent a sample of the Saudi population.

Among all variant types of RPSBD, we found that, HCS was more frequently found in type-I RPSBD anatomy in Saudi AND non-Saudi and were 8% (16/199) vs 10.5% (4/38) so the differences were not significant. Type 2 RPSBD anatomy is the second most common anatomical variant with frequent positive sign in Saudi and non-Saudi, 6.5% (13) vs 5.3 (2/38) respectively. We did encounter low incidence of type-III HCS, in which the RPSBD drains into the common bile duct (Table 3). Incidence of this anatomic variation has been reported before as 'Cysticohepatic Ducts' and its prevalence is very low (1-2%). Our observation is consistent with other studies that reported only 2% of the cases the RPSBD drained into the cystic duct. Another report revealed only 1% cholangiograms depicted an anomalous RHD, which emptied into the cystic duct. Prior information on HCS will help in dealing with the anatomical abnormality especially in the context of RPSBD, where the cystic duct can be ligated between the gallbladder and the point at which the duct joins [27,28].

Likewise, avoiding biliary complications for both donor and recipient in Living Donor Liver Transplantation (LDLT) is critical to achieve safety for both. One of the major biliary complications in patients undergoing LDLT is the anatomical limitations contributed by multiple tiny bile ducts and the differential blood supplies. Recognizing these anomalies with aid of HCS preoperatively, this may result in dramatic drop in the incidence of biliary complications and improve outcome and selection of donors in LDLT in Saudi populations.

A limitation of this study was that it did not evaluate the patterns of HCS in a healthy population [29]. This study included patients without any prior history of liver resection or biliary instrumentation. Irrespective of that, our data may be more representative of the general Saudi population than data from other populations obtained in carefully selected liver donors.

In conclusion, our study reveals that type-I and type II RPSBD anatomical variation is more commonly to show positive HCS in Saudi patients than any other type. Prior knowledge of this sign is essential to achieve curative resection in some cases with an abnormal pattern of the RPSBD. Since elusive knowledge of the biliary anatomy at hepatic hilum in hepatobiliary surgery may easily lead to postoperative biliary complication [4,8], preoperative recognition as well as intraoperative understanding of the RPSBD is apparently important for safe and curative resection in patients with aberrant biliary system. Although biliary complications after LDLT continue to be challenging, to obtain a more favorable outcome, proper evaluation of HCS may contribute as a significant factor in the pathophysiological mechanisms of biliary complications in LDLT. In addition, when left-sided hepatectomy is indicat-

ed in patients with HCS, diagnosis of the confluence patterns of the RPSBD may be clinically useful, and should be well-recognized by biliary surgeons.

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