ORIGINAL ARTICLE

Evaluation of Variants in Hepatic Artery Anatomy on Conventional Angiography in Patients Undergoing Transarterial Chemoembolization (TACE): Experience at SIUT

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ABSTRACT

Objective: The purpose of this research is to evaluate common and uncommon variant of hepatic arterial anatomy that usually come across during Hepatic Angiographies.
Study Design: Cross sectional study.
Methods: This study included 50 patients having history of Hepatocellular Carcinoma from May to October 2015. Hepatic Angiography (Transarterial chemoembolization for management of Hepatoma and identification of classical and variant anatomy of hepatic artery) was evaluated in angiography unit. All procedures were performed on Digital Subtraction Angiography (DSA) machine (Toshiba KXO100 G). Selective DSA of the superior mesenteric artery and celiac trunk is performed initially to evaluate the frequency of normal and variant arterial anatomy and secondly to determine origin and course of tumor-feeding vessels. Evaluation of common and uncommon variants of hepatic arteries was done by using Michel's classification as reference standard.
Results: Age of the patient range from 40 – 80 years, 35 of whom were males. Fifty patients underwent angiographic procedure of viscera. Normal anatomy of hepatic artery was found in twenty eight (56%) cases. In six (12%) cases we found the replaced form of right hepatic artery (RHA) originating from visceral superior mesenteric artery. In five (10%) cases we found the replaced form of left hepatic artery (LHA) originating from left gastric artery (LGA), the combination of both these anomalies in one (2%) patient. Four (8%) cases had the left gastric artery giving rise to accessory left hepatic artery in conjunction with the common hepatic artery of celiac axis giving rise to typical right or left hepatic artery. In another four (8%) cases anatomic variation was noted in form of a dual arterial supply noted as common hepatic artery of celiac axis giving rise to typical left or right hepatic artery in conjunction with superior mesenteric artery giving rise to accessory right hepatic artery. In two (4%) cases superior mesenteric artery had replaced the celiac trunk completely.
Conclusion: Visceral angiography with evaluation of common and uncommon variants of hepatic artery are very crucial not only for proper preoperative evaluation in hepato biliary surgeries but also in many diagnostic and therapeutic interventional procedures. We have found that it is of utmost importance to have a detailed and complete information and understanding of anatomic variations of hepatic artery both common and uncommon variants in order to avoid hazardous complications which can happen with incomplete information.

Key words: Variants, Hepatic artery, Angiography, Transarterial Chemoembolization.

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INTRODUCTION

The vascular variations are usually asymptomatic until and unless they cause interruption of blood supply to organs. They are usually diagnosed during surgeries, angiographic procedures or autopsies. Variations in anatomy of hepatic artery are one of rare variants[1]. For many practitioners including general surgeons and those have specialty in hepato-biliary surgeries, the knowledge about variants in anatomy of hepatic artery has great impact in outcomes of result. This also has same significance in daily practice of interventional radiologists who are treating hepatic tumors by transarterial chemoembolization[2].

There is variability in the anatomy of vessels in liver.[3] Most of the times the celiac trunk gives rise to common hepatic artery which further divides into proper hepatic artery and gastroduodenal artery. The proper hepatic artery further gives rise to right and left hepatic artery. [4, 5.] Great variation has been shown by Yamagami et al [6] with origin of right hepatic artery. In 51% of cases

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the proper hepatic artery gives rise to right hepatic artery[6] In 23% of cases it originates from left branch of hepatic artery. In 9% of cases it originates from common hepatic artery. In 3% of cases the gastroduodenal artery gives rise to right hepatic artery 55% to 77% of population have the classical anatomy of hepatic artery [7, 8] while 25-50% of population have variations in anatomy of arterial supply to liver[9]. In 1955 Michels NA [10] proposed an international system of classification regarding anatomical variations of vascular supply to liver. The various experiences have been also published by Vandamme et al [11] in 1969. On surgical importance the research has been also contributed by Suzuki et al [12] regarding variations in anatomy of hepatic artery in 1971. Also other very rare variants of hepatic artery have also been described in various surgical, radiological and many anatomical studies. [5,13,14].

The risks due to iatrogenic complications can be reduced by proper preoperative anatomical update of hepatic vascular pattern. This context the outcomes of results will be better for radiological treatments and surgical interventions. [15.1].

Thus, for the purpose of the evaluation of vascular pattern Digital Subtraction Angiography (DSA) is regarded as a gold standard. DSA images give better visualization of all hepatic arteries supplying the hepatic parenchyma, regardless of their origin in context of both radiological treatments and surgical interventions. The objective of our study is to evaluate the classic hepatic arterial anatomy and its variations in the patients at the time of hepatic angiographies to avoid potentially disastrous complications and to achieve better results in both radiological treatments and surgical interventions.

METHODS

This cross-sectional study was carried out at Department of Radiology, Sindh Institute of Urology & Transplantation (SIUT). Patients having Hepatocellular carcinoma either resectable or un-resectable were referred to Radiology department through Gastroenterology department of SIUT for Transarterial chemoembolization (TACE). Total 50 patients of both genders, aged 40-80 years were included in this study. Patients having any extrahepatic tumors, ascites, obstructive jaundice with bilirubin level of greater than 3.0 mg/dl and those had portal vein thrombosis were excluded from study. The approval of institutional research & ethical committee and informed consent were taken prior to the study.

Hepatic Angiography was performed in angiography suite. All procedures were performed on Angiography machine (Toshiba KXO100 G) at frame rate of 3 frames/sec, 76kvp, 160mA and 39ms. Selective Digital subtraction angiography of the celiac trunk and superior mesenteric artery was performed first to determine the frequency of normal and variant arterial anatomy and secondly to determine origin and course of tumor-feeding vessels. Evaluation of common and uncommon variants of hepatic arteries was done by using Michel's classification as reference standard[10].

During Angiography after all aseptic measures under local anesthetic a puncture was made in the common femoral artery with the help of 18G angiography needle. Standard guide wire 0.035x150cm is introduced into the needle; 5Fr angiographic vascular sheath was slided over the guide wire after the removal of the needle. To achieve complete angiographic evaluation of all hepatic arteries supplying the hepatic parenchyma, regardless of their origin before surgical planning, Celiac and superior mesenteric angiogram was performed to determine the frequency of normal and variant arterial anatomy and secondly to determine origin and course of tumor-feeding vessels. Superior mesenteric artery was catheterized by a 4-Fr catheter (Cobra/Renal double curve/Multipurpose) and superior mesenteric angiogram was obtained for evaluation of aberrant hepatic arteries that arise from portal vein and superior mesenteric artery. Power injector was used at a flow rate of 3mL/sec using 30 mL of Iopromide and with same catheter celiac angiogram was obtained using 25-35 mL of same contrast at flow rate of 5-7mL/sec. We had obtained 11-14 images during angiogram of portal vein and superior mesenteric artery and 8-10 images during celiac angiogram. Using micro catheter, feeding artery of Hepatocellular carcinoma is cannulated super selectively and chemoembolic material and lipoidal is injected.

STATISTICAL ANALYSIS: Data were initially collected on Proforma. Statistical analysis was performed with SPSS version 20. Frequencies and percentages were calculated for hepatic artery variations.

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008. Informed consent was obtained from all patients for being included in the study.

RESULT

This study included 50 patients age ranges 40-80years,

35 (70%) of whom were males and 15 (30%) were females.

Standard hepatic anatomy, which in Michel's classification is type I was found in twenty-eight (56%) cases, while twenty-two (44%) cases showed anomalous arterial patterns (Table 1). In type II the left gastric artery gave rise to replaced left hepatic artery in five cases (10%). In type III the superior mesenteric artery gave rise to replaced right hepatic artery in six cases (12%), and in type IV we observed mixed combination of these two patterns was found in one case (2%). Type V was noted in four cases (8%), in which common hepatic artery gave rise to left or right hepatic artery and left gastric artery gave rise to accessory left hepatic artery in four cases (8%). Type VI was seen in four cases (8%) where the common hepatic artery gave rise to left or right hepatic artery and superior mesenteric artery gives rise to accessory right hepatic artery. Type IX was observed in two cases (4%) in which superior mesenteric artery replaces the hepatic trunk completely. We found no case of Michel's VII and VIII variety which were combination of triple arterial supply to liver. Also type X Michel's in which left gastric artery replaces hepatic trunk, was not found in any case. (Table 2).

Table 1: Standard and Anatomic Variations

DESCRIPTION	MICHEL'S	CURRENT Number(n) (%)
Standard Anatomy	55	56
Anatomic Variations	45	44

Table 2: Hepatic Arterial Variation Percentage

TYPE	DESCRIPTION	MICHELS (%)	CURRENT SERIES (%)
I	Standard Anatomy	55	56
II	Repl. LHA from LGA	10	10
III	Repl. RHA from SMA	11	12
IV	Repl. LHA from LGA and repl. RHA from SMA	1	2
V	Acc. LHA from LGA	8	8
VI	Acc. RHA from SMA	7	8
VII	Acc. LHA from LGA and acc. RHA from SMA	1	-
VIII	Acc. RHA/ LHA+ Repl. LHA or RHA	2	-
IX	CHA from SMA	4.5	4
X	CHA from LGA	0.5	-

DISCUSSION

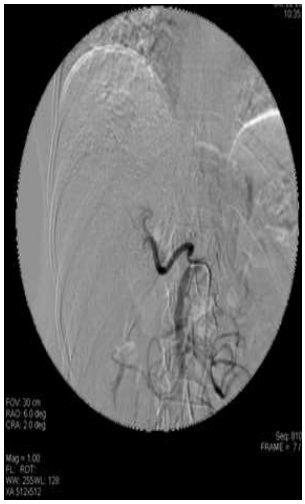
Classic vascular anatomy serves as guide to understanding the vascular supply. The treatment of both primary and metastatic hepatic neoplastic lesions by surgical and interventional techniques [17, 18] the exact evaluation of anatomy of hepatic artery is very crucial. In both hepatic and general surgeries, mainly in liver transplantation procedure, the sound knowledge of anatomy of hepatic artery is of great importance. It has also pivotal role in certain radiological interventional procedures such as transarterial chemo-embolization of hepatic neoplastic lesions. There are certain factors which can lead to technical difficulties like variation in vascularization of hepatic artery and when there is presence of significant arterial feeders of extra hepatic tumors. [15.2]

Normally three branches arise from the celiac trunk which arises from aorta [16], which are common hepatic artery, splenic artery and left gastric artery. The common hepatic artery further gives rise to hepatic artery proper and gastroduodenal artery. Then hepatic artery proper gives rise to left and right hepatic arteries. On basis of angiographic reports and cadaveric studies this normal arterial pattern has been reported in about 50% of cases [10-12]. Variants are developmental changes of the primitive ventral splanchnic arteries. All the classical variations can consequently be explained by the abnormal disappearance of an arterial segment that should normally persist, persistence of an arterial segment that should disappear, or both. In 1955, Michels proposed the main classification regarding variation in anatomy of vascular supply of liver [10] and established the clear concept of difference between a replaced artery and an accessory artery[19]. After Michels initial classification, several authors described their own observations [12, 20]. However, Michels classification served as the benchmark for all subsequent contributions [20-24].

In Michels study based on 200 cadaver dissections, 55% showed classic or standard anatomy and 45% showed anatomic variation [10]. Our study was based of arteriography, has almost similar results with 56% classic or standard anatomy and 44% anatomic variants. However, we did not find any case of Type VII, VIII and X variant which were 1-2% in Michels study. Another study by Suzuki et al included 200 cases of arteriography, classified into three groups based on number of hepatic arteries. The single hepatic artery group corresponding to classic anatomy was 58.5%, double hepatic artery (with single replaced/accessory artery) 37.0% and multiple hepatic arteries (replaced/accessory/aberrant) were 4.5% [12]. Our study was also based on arteriography and showed slight less single hepatic artery/classic anatomy (56%), however, double hepatic artery group (CHA with single replaced/accessory artery) 40% and multiple hepatic artery group only 2%. We also had two cases of type

IX variant, in which CHA originated from superior mesenteric artery (SMA).

Great variation was shown shown by Yamagami et al with origin of right hepatic artery. In 51% of cases the proper hepatic artery gave rise to right hepatic artery. In 23% of cases it originated from left branch of hepatic artery. In 9% of cases it originated from common hepatic artery and in 3% of cases the gastroduodenal artery gave rise to right hepatic artery [6]. In this study right hepatic artery originated from common or proper hepatic artery (CHA) in 60% and from SMA in 22% cases. Thus, our study supported previous literature with minor differences which may be statistical or due to difference in population group. This will add local data to international literature and would be helpful to minimize the chances of serious complications during abdominal surgeries and interventional procedure.



Type 4:Left hepatic artery from left gastric artery and right hepatic artery from superior mesenteric artery

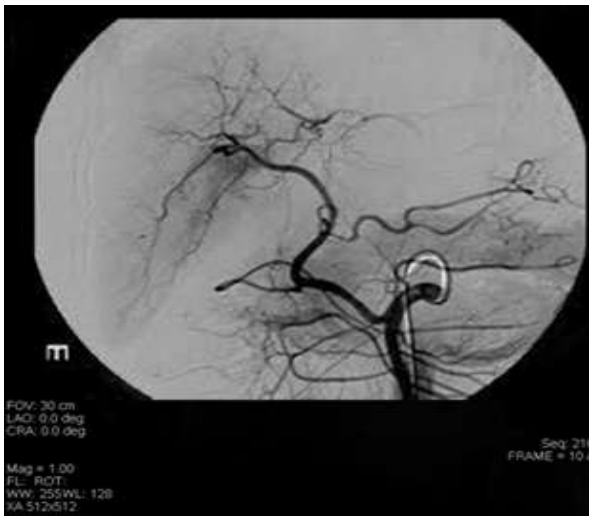
Type1: Standard anatomy, normal hepatic arteries

Type 2: Left hepatic artery from left gastric artery

Type 5: accessory left hepatic artery from left gastric artery

Type 6: accessory right hepatic artery from superior mesenteric artery

Type 3:Right hepatic artery from superior mesenteric artery



Type 7:common hepatic artery from superior mesenteric artery

CONCLUSION

It was found that hepatic artery had many anatomic variations which were seen in our study. To recognize them is of utmost importance in order to avoid hazardous complications which can occur during conventional angiography for Transarterial Chemoembolization.

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