ORIGINAL ARTICLE

Diagnostic Accuracy of MDCT in Evaluating Hepatic Arterial Anatomy of HCC Patients Undergoing TACE taking DSA as Gold Standard

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ABSTRACT

Background: Anatomical variations of the hepatic arteries and coeliac trunk are of considerable importance in liver transplants, radiological abdominal interventions and penetrating injuries to the abdomen.
Aim: To determine the diagnostic accuracy of MDCT in evaluating hepatic arterial anatomic variations of HCC patients undergoing TACE taking DSA as gold standard**.**
Study Design: Cross Sectional Survey
Setting: Radiology Department in collaboration with Department of Gastroenterology, Hepatobilliary Surgery & Liver Transplant Unit of Shaikh Zayed Hospital, Lahore.
Duration of study: Six months from 01-07-2013 to 31-12-2013.
Results: Mean age of the patients was 50.27±12.03 years. 149 patients (59.8%) were male while remaining 100 patients (40.2%) were female. sensitivity, specificity, diagnostic accuracy, PPV, NPV of MDCT (main hepatic artery) as follows: 99.5%, 81.2%, 98.3%, 98.7% and 98.8%, respectively. sensitivity, specificity, diagnostic accuracy, PPV, NPV of MDCT (hepatic artery proper) as follows: 100%, 77.7%, 99.1%, 99.1% and 100%, respectively. sensitivity, specificity, diagnostic accuracy, PPV, NPV of MDCT (left hepatic artery) as follows: 99.5%, 95.9%, 98.7%, 99.0% and 97.9%, respectively. sensitivity, specificity, diagnostic accuracy, PPV, NPV of MDCT (right hepatic artery) as follows: 98.5%, 87.1%, 96.7%, 97.6% and 91.8%, respectively. sensitivity, specificity, diagnostic accuracy, PPV respectively.
Conclusion: MDCT angiography permits an accurate and detailed analysis of hepatic arterial anatomic variations of HCC patients. Angiographic information required to determine treatment options and to prevent complications arising from anatomic variations during surgery or intervention can easily be obtained using MDCT.
Keywords: Hepatocellular Carcinoma, MDCT, DSA

INTRODUCTION

Hepatocellular Carcinoma (HCC) is one of the most common malignancies worldwide, causing an estimated one million deaths annually[1]. The major load of HCC lies in developing countries; sharing 82% burden of HCC cases with relatively high incidence in South East Asia and in Sub-Saharan Africa. In Pakistan for more than two decades (from 1970s till mid 1990s), hepatitis B was the most common causative factor for hepatocellular carcinoma (HCC) which latter on shifted to hepatitis C virus (HCV) related HCC cases[2].

Transarterial chemoembolization (TACE) is the mainstay of treatment for patients with unresectable hepatocellular carcinoma (HCC). TACE combines the effect of targeted chemotherapy with the effect of ischemic necrosis induced by arterial embolization.[3] The purpose of TACE is to control tumor growth causing tumor necrosis, while securing as much functional liver tissue as possible. As a neoadjuvant therapy prior to liver resection, TACE showed 70% tumor control.[4] The hepatic arterial anatomy has been demonstrated to have multiple variants and plays important role when considering pre-surgical planning, catheterization and transarterial chemoembolization[5].

Normal hepatic arterial anatomy occurs in approximately 50–80% of cases[6,7]. In normal conventional anatomy, the main hepatic artery originating from celiac trunk gives off the gastroduodenal artery and the proper hepatic artery, and the proper hepatic artery splits into the left and the right hepatic arteries. In most frequent variation (6%-15.5% of all cases) right hepatic artery is replaced, originating from the superior mesenteric artery. The second most frequent variation, replaced left hepatic artery originating from the left gastric artery, was reported in 2.5%–10% of all cases. Whereas, other variants including the accessory left and right hepatic artery originating respectively from left gastric artery and the superior mesenteric artery have also been reported. Digital subtraction angiography (DSA) is considered gold standard in the assessment of vascular structures, although its invasive nature significantly limits its role. With recent advances in multidetector computed tomography (MDCT) technology, even vascular structures with very small diameters can be depicted easily, and as a consequence, the number of the invasive DSA examinations has been reduced[7]. A study conducted in Thailand and published in 2008 has shown sensitivity, specificity and accuracy of MDCT in evaluating hepatic artery anatomic variations to be 61.5%, 100% and 82.6% respectively[5], whereas another study recently published in 2012 in Egypt has revealed sensitivity, specificity and accuracy of MDCT to be 100% each[8], while in Taiwan another study concluded sensitivity, specificity and accuracy of MDCT as 94%, 97% and 96%[9].

The objective of the study was to determine the diagnostic accuracy of MDCT in evaluating hepatic arterial anatomic variations of HCC patients undergoing TACE taking DSA as gold standard.

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METHODOLOGY

This cross sectional study was carried out in Radiology Department in collaboration with Department of Gastroenterology, Hepatobilliary Surgery & Liver Transplant Unit from 01-07-2013 to 31-12-2013 at Shaikh Zayed Hospital, Lahore. A total of 249 patients were included in this study. After an informed consent, patients fulfilling the inclusion criteria was enrolled in the study.

Biphasic CT scan was obtained through standard protocols on a 64 slice Multi Detector CT scanner (Light Speed VCT, General Electric Medical Systems) using 1ml/Kg of non-ionic contrast medium. After acquiring biphasic CT Scan, arterial angiography of mesenteric and hepatic vasculature bed will be obtained with a standard reconstruction algorithm on AW 4.4_04 Volume Share 2. Digital subtraction angiography of celiac trunk and superior mesenteric artery was done through standard protocols on Toshiba INFINIX/CC 1000 mA Angiography machine while performing TACE. The main hepatic artery, hepatic artery proper, right and left hepatic arteries were evaluated in terms of being normal, replaced or accessory in origin through standard reconstruction algorithm of MDCT and latter its diagnostic accuracy was verified with DSA findings being recorded at the time of performing TACE. To avoid any controversy, all these findings of MDCT and DSA in terms of having normal anatomy or variant anatomy was assessed by a single consultant to determine the diagnostic accuracy of Multi Detector Computed Tomography (MDCT) taking DSA as gold standard. Data was collected as per proforma annexed.

Quantitative variable was age and calculated as Mean+SD. Qualitative variables like gender and presence of variations of hepatic arterial bed was presented by frequency and percentages. A 2x2 contingency table was generated to calculate sensitivity, specificity, positive predictive value and negative predictive value by taking DSA as gold standard.

RESULTS

Majority of the patients were between 41-60 years of age and minimum patients were 61-70 years old. Mean age of the patients was 50.27±12.03 years (Table 1). Out of 249 cases, 149 patients (59.8%) were male while remaining 100 patients (40.2%) were female (Table 2).

Comparison of MDCT findings vs DSA (Main hepatic artery), reveals 235 normal and 14 variant on MDCT while 233 normal and 16 variant on digital subtraction angiography (DSA) (Gold Standard) (Table 3). Sensitivity, Specificity, diagnostic accuracy, PPV, NPV of MDCT (Main hepatic artery) as follows: 99.5%, 81.2%, 98.3%, 98.7% and 98.8%, respectively.

Comparison of MDCT findings vs DSA (Hepatic artery proper), reveals 242 normal and 7 variant on MDCT while 240 normal and 9 variant on digital subtraction angiography (DSA) (Gold Standard) (Table 4). Sensitivity, Specificity, diagnostic accuracy, PPV, NPV of MDCT (Hepatic artery proper) as follows: 100%, 77.7%, 99.1%, 99.1% and 100%, respectively.

Comparison of MDCT findings vs DSA (Left hepatic artery), reveals 201 normal and 48 variant on MDCT while 200 normal and 49 variant on digital subtraction angiography (DSA) (Gold Standard) (Table 5). Sensitivity, Specificity, diagnostic accuracy, PPV, NPV of MDCT (Left hepatic artery) as follows: 99.5%, 95.9%, 98.7%, 99% and 97.9%, respectively. Comparison of MDCT findings vs DSA (Right hepatic artery), reveals 212 normal and 37 variant on MDCT while 210 normal and 39 variant on digital subtraction angiography (DSA) (Gold Standard) (Table 6). Sensitivity, Specificity, diagnostic accuracy, PPV, NPV of MDCT (Right hepatic artery) as follows: 98.5%, 87.1%, 96.7%, 97.6% and 91.8%, respectively.

Comparison of MDCT findings vs DSA (hepatic arterial anatomic variation), reveals 243 normal and 6 variant on MDCT while 243 normal and 6 variant on digital subtraction angiography (DSA) (Gold Standard) (Table 7). Sensitivity, Specificity, diagnostic accuracy, PPV, NPV of MDCT (hepatic arterial anatomic variation) as follows: 99.5%, 83.3%, 99.1%, 99.5% and 83.3%, respectively.

Table 1: Distribution of cases by age (n=249)

Age (Year)	n	%age
20-40	56	22.5
41-60	146	58.6
61-70	47	18.9
Mean±SD	50.27±12.03	

Table 2: Distribution of cases by gender

Gender	n	%age
Male	149	59.8
Female	100	40.2

Table 3: Comparison of MDCT findings vs DSA

MDCT	Digital Subtraction angiography (DSA) (Gold Standard)		Total
	Normal	Variant	
Normal	232 (TP)	3 (FP)	235
Variant	1 (FN)	13 (TN)	14

Table 4: Comparison of MDCT findings vs DSA

MDCT	Digital Subtraction angiography (DSA) (Gold Standard)		Total
	Normal	Variant	
Normal	240 (TP)	2 (FP)	242
Variant	0 (FN)	7 (TN)	7

Table 5: Comparison of MDCT findings vs DSA

MDCT	Digital Subtraction angiography (DSA)(Gold Standard)		Total
	Normal	Variant	
Normal	199 (TP)	2 (FP)	201
Variant	1 (FN)	47 (TN)	48

Table 6: Comparison of MDCT findings vs DSA

MDCT	Digital Subtraction angiography (DSA) (Gold Standard)		Total
	Normal	Variant	
Normal	207 (TP)	5 (FP)	212
Variant	3 (FN)	34 (TN)	37

Table 7: Comparison of MDCT findings vs DSA

MDCT	Digital Subtraction angiography (DSA) (Gold Standard)		Total
	Normal	Variant	
Normal	242 (TP)	1 (FP)	243
Variant	1 (FN)	5 (TN)	6

DISCUSSION

Anatomical variations of the hepatic arteries and coeliac trunk are of considerable importance in liver transplants, laparoscopic surgery, radiological abdominal interventions and penetrating injuries to the abdomen[10] The frequency of inadvertent or iatrogenic hepatic vascular injury rises in the event of aberrant anatomy and variations. Arterial vascularisation of the gastrointestinal system is provided by anterior branches at three different levels of the abdominal aorta (the coeliac trunk and the superior and inferior mesenteric arteries). Differences arising during several developmental stages in the embryonal process lead to a range of variations in these vascular structures[11].

Renal artery variations are not uncommon either and give rise to several problems that are encountered by clinicians. Kidneys with a large number of renal arteries are reported to have a higher rate of transplantation failure than those with a single renal artery[10]. The risk represented by these vascular variations is not, however, limited to renal transplantations and to the surgical treatment of renovascular hypertension[12].

DSA is regarded as the gold standard in the evaluation of vascular structures. Nevertheless, some variations can be overlooked when this technology is used in cases where description of the hepatic arterial system is difficult, where the catheter tip is far from where it should be in the coeliac trunk during selective angiographic processes, or when a high-quality angiograph cannot be obtained[13]. MDCT angiography allows most of the body to be scanned helically in just one breath hold, and thus provides high-contrast resolution without any artefacts. Together with axial images, 3D images provide a very good anatomical orientation. Hence, detailed information regarding vascular structures, organs and their relations with one another can be obtained[14].

The kidneys, which are located inside the pelvis during the embryological period, obtain their blood supply from blood vessels in that region. Initially, the renal arteries take their origin from the common iliac arteries. As the kidneys ascend, blood supply is obtained from the distal end of the aorta. When they ascend further, the kidneys receive blood from new aortic branches. As the kidneys reach their final destination, they are fed by true permanent renal arteries from the abdominal aorta and the previous caudal renal feeders undergo involution. The wide variations observed in the kidneys' blood supply are the result of these changes in the organs' blood supplies during embryological and early foetal life. Accessory kidney arteries sometimes enter the kidney directly from the superior or inferior renal poles. An accessory artery in the inferior renal pole crosses the ureter obliquely from its anterior aspect, and may lead to hydronephrosis by compressing the ureter. It is important to be aware that accessory renal arteries are not juvenile arteries whose function has been superseded, and thus ligation of an accessory renal artery ends up with ischaemic damage to the supplied portion of the kidney. Therefore, a knowledge of variations in renal vasculature is of crucial importance for interventions involving the kidney arteries or abdominal aorta[15].

Present study has shown sensitivity, specificity and diagnostic accuracy of MDCT in evaluating hepatic artery anatomic variations to be 99.5%, 83.3% and 99.1%, respectively. Our results are comparable with the study of Prabhasavat and Homgade[5]. Another other study carried out by Ali et al[8] in 2012 demonstrated sensitivity, specificity and accuracy of MDCT to be 100% each which is close to our findings. Yu et al[9] also showed results consistent with our study.

CONCLUSION

In conclusion, MDCT angiography permits an accurate and detailed analysis of hepatic arterial anatomic variations of HCC patients. Angiographic information required to determine treatment options and to prevent complications arising from anatomic variations during surgery or intervention can easily be obtained using MDCT. The likelihood of coeliac trunk and/or hepatic arterial variation rises in those individuals with more than one renal artery.

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