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Article *in* International Journal of Anatomy and Research · January 2015

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# MORPHOLOGICAL VARIATIONS OF CAUDATE LOBE OF THE LIVER AND THEIR CLINICAL IMPLICATIONS

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## ABSTRACT

**Background:** Knowledge of normal and variant anatomy of the caudate lobe of the liver is a prerequisite for better surgical outcome. Morphology of the caudate lobe has significance in diagnostic imaging and also minimally invasive surgical approaches. So we have taken up this study to know the detailed morphology of the caudate lobe.

**Materials and methods:** The morphology of caudate lobe was studied in 100 formalin fixed adult livers obtained from the department of anatomy, Kempegowda institute of medical sciences and Bangalore medical college, Bangalore. The livers were studied for the morphological variations of the caudate lobe.

**Results:** Various shapes of the caudate lobe were noticed. Vertical fissure extending upwards from lower border was seen in 30%. Prominent papillary process was seen in 21%. Prominent caudate process was seen in 9%.

**Discussion:** Various shapes of the caudate lobe were encountered in the present study. Sahni et al and Joshi SD et al also reported a variety of shapes of the caudate lobe. Vertical fissure extending upwards from the inferior border was seen in 30% of the livers. Kogure et al noticed the notch in approximately half of the patients undergoing hepatectomy. Kogure et al also noted that the external notch may be a vestige of the portal segmentation of the caudate lobe. Prominent papillary process was observed in 21% of the livers. Joshi SD et al have also found prominent papillary process in 33% of the livers in their study. Auh et al observed that on CT (Computed Tomography), a normal or small papillary process may be mistaken for enlarged porta hepatis lymph nodes. When enlarged papillary process extends on to left side it can mimic pancreatic body mass.

**Conclusion:** The incidence of morphological variations of caudate lobe is very high in this study. The papillary process of caudate lobe is a potential source of pitfalls in interpretation of CT images at and just below the porta hepatis. Knowledge of these variations is important for radiologists to achieve correct diagnosis and for surgeons to plan for surgery and to achieve good surgical outcome.

**KEY WORDS:** Caudate Lobe, Caudate Process, Papillary Process, Accessory Fissures.

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DOI: 10.16965/ijar.2015.119

**Web site:** International Journal of Anatomy and Research  
ISSN 2321-4287  
[www.ijmhr.org/ijar.htm](http://www.ijmhr.org/ijar.htm)

Received: 14 Feb 2015

Accepted: 02 Apr 2015

Peer Review: 14 Feb 2015

Published (O): 30 Apr 2015

Revised: 26 Feb 2015

Published (P): 30 June 2015

## INTRODUCTION

The gross anatomical appearance of the liver has been divided into Right, left, caudate and

quadrate lobes by the peritoneal reflections and attachment of ligaments [1]. Caudate lobe is a separate and distinct liver lobe; it is located on

the posterior surface of the liver, between the groove for inferior vena cava (IVC) to the right, fissure for ligamentum venosum to the left and porta hepatis anteriorly [2]. The caudate lobe is comprised of two portions joined by a narrow parenchymal bridge the caudate isthmus. One is to the left of IVC, the Spiegel's lobe or Couinaud's segment, the second part extends in front and to the right of IVC, the paracaval portion. The right anterior part is connected to the right lobe by the caudate process and the inferior surface of the caudate lobe may present a small rounded projection called papillary process [3]. Recently caudate lobe has acquired considerable importance because of its own vascularisation and biliary drainage. Caudate lobe is a central structure seen readily on abdominal imaging. Caudate anatomy is complex, may cause difficulties in the interpretation of cross sectional images [4]. Caudate lobectomy for localized tumors was a controversial topic in 1990s, but it is now considered to be the most appropriate treatment for benign tumors of the caudate lobe [2]. Safe resection of the caudate lobe is still a major challenge. Thus a prior knowledge of the caudate lobe anatomy is very essential for better surgical approach and outcome. So this study has been taken up to briefly review the morphology of caudate lobe.

## MATERIALS AND METHODS

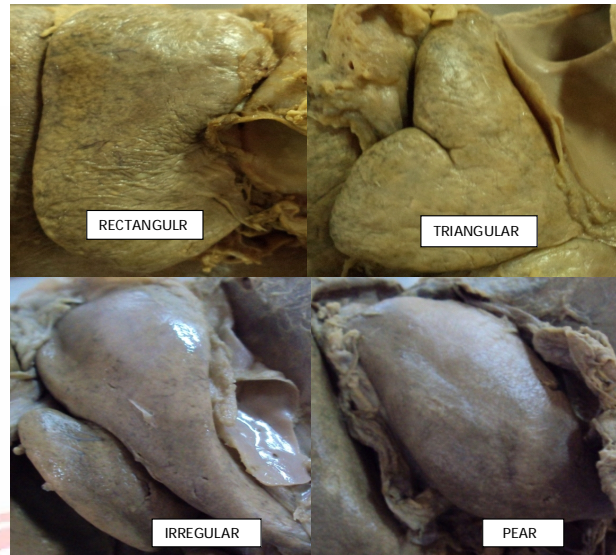
This study was done on 100 formalin fixed adult human livers irrespective of the sex obtained from the department of anatomy, Kempegowda institute of medical sciences and Bangalore medical college, Bangalore. Livers with diseases and surgical resections were excluded from the study. The gross anatomy of caudate lobe was studied for its shape, presence of fissures or notch and variations in the caudate and papillary processes.

## RESULTS

Various shapes of the caudate lobe were observed (shown in fig 1). It was rectangular in 58%, pear shaped in 10%, irregular in 20%, triangular in 8%, others (square, heart shape, inverted pear) in 4%. Vertical fissure extending upwards from lower border was seen in 30 % (shown in fig 2). Prominent papillary process was seen in 21 % (shown in fig 3). Prominent caudate

process was seen in 9 % (shown in fig 4).

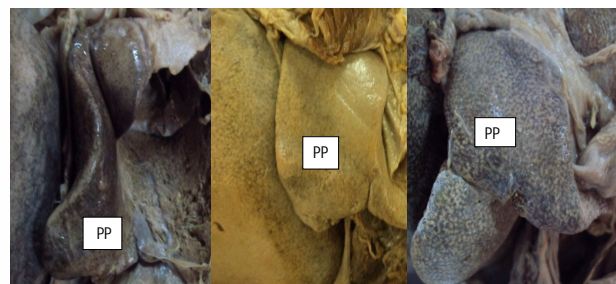
**Fig. 1:** Showing various shapes of the caudate lobe.



**Fig. 2:** Showing vertical fissure / notch (arrow is pointing at the fissure).



**Fig. 3:** Showing prominent papillary process (PP- papillary process).



**Fig. 4:** Showing prominent caudate process (CP- caudate process).



## DISCUSSION

Various shapes of the caudate lobe were encountered in the present study. Sahni et al [6] and Joshi SD et al [3] also reported a variety of shapes of the caudate lobe (shown in table1).

Variations of Caudate lobe		Joshi et al (90 livers)	Present study (100 livers)
<b>SHAPE</b>	Rectangular	58%	48%
	Pear	10%	18%
	Irregular	20%	16%
	Triangular	8%	12%
	Others	4%	6%
<b>NOTCH</b>		18%	31%
<b>VERTICAL FISSURE</b>		30%	30%
<b>PAPILLARY PROCESS</b>		32%	21%
<b>CAUDATE PROCESS</b>		-	9%

**Table 1:** Comparison of morphological variations of caudate lobe.

The presence of notch on the inferior border of CL, separating the caudate process and papillary process, was seen in 31% of the specimens, vertical fissure extending upwards from the inferior border was seen in 30% of the livers. Kogure et al [7] noticed the notch in approximately half of the patients undergoing hepatectomy. On corrosion cast studies they confirmed the presence of a portal fissure between the spiegel's lobe and the paracaval portions, and they also proposed that the external notch can be used as an index to separate both the parts of caudate lobe. Sahni et al observed that the frequency of occurrence of the notch decreased with the advancing age [6]. Kogure et al also noted that the external notch may be a vestige of the portal segmentation of the caudate lobe [7]. Couinaud reported that in 34 of 96 cases, hepatic vein lie in the plane of the vertical fissure [3].

Prominent papillary process was observed in 21% of the livers. Joshi SD et al [3] have also found prominent papillary process in 33% of the livers in their study. The probability of misinterpretation of computed tomographic (CT) images increases if the papillary process is involved in diseases or when papillary process is enlarged.

The normal anatomy of the caudate lobe can create several pitfalls that may lead mistakenly to a diagnosis of disease. Auh et al observed

that on CT, a normal or small papillary process may be mistaken for enlarged porta hepatis lymph nodes. It is known that the enlarged papillary process can displace the gastric antrum and duodenum anteriorly, thus mimicking a right sided retroperitoneal mass [5].

When enlarged papillary process extends on to left side it can mimic pancreatic body mass, such an enlargement is common in cirrhosis of liver. Caudate lobe enlargement commonly accompanies occlusion of the hepatic veins; along with patchy areas of low and high attenuation on CT. The explanation given is that the venous drainage of caudate lobe is by the emissary veins that pass directly from caudate lobe to inferior vena cava [4].

## CONCLUSION

The incidence of morphological variations of caudate lobe is very high in this study. These variations should be kept in mind in order to achieve correct preoperative diagnosis, thus it will be helpful for the surgeon in planning for surgeries on caudate lobe of liver. The papillary process of caudate lobe is a potential source of pitfalls in interpretation of CT images at and just below the porta hepatis. These errors can be avoided if the CT images are analysed carefully with reference to the gross anatomy of caudate lobe.

**Conflicts of Interests: None**

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**How to cite this article:**

Sarala HS, Jyothilakshmi TK, Shubha R. MORPHOLOGICAL VARIATIONS OF CAUDATE LOBE OF THE LIVER AND THEIR CLINICAL IMPLICATIONS. *Int J Anat Res* 2015;3(2):980-983.

**DOI:** 10.16965/ijar.2015.119