

# Accessory sulci of the liver

## An anatomical study with clinical implications

Faizah B. Othman, MD, PhD, Azian A. Latiff, MD, PhD, Faribah H. Suhaimi, MBBS, PhD, Srijit Das, MBBS, MS.

### ABSTRACT

**الأهداف:** من أجل دراسة وجود الأخداد الإضافية (AS) في كبد جثة محشطة ومقارنتها مع كبد طبيعية.

**الطريقة:** أجريت هذه الدراسة على 40 كبد من جثث محشطة بقسم التشريح - جامعة ماليزيا الوطنية - كوالالمبور - ماليزيا، خلال الفترة ما بين سبتمبر 2007م حتى أكتوبر 2007م. وذلك من أجل مراقبة الوجود ونوع الأخداد الإضافية (AS) التشريحي.

**النتائج:** من بين العينات الأربعين التي أجريت عليها الدراسة، لاحظنا وجود الأخداد الإضافية (AS) لدى عيتيتين فقط (5%). كان موقعها في أسفل وخلف سطح الفصوص اليميني لدى عيتيتين على التوالي.

**خاتمة:** تعتبر الأخداد الإضافية (AS) للكبد شذوذ نادر. لقد قامت الأبحاث الدراسية في الماضي بوصف الأخداد الحجاجية في الكبد ولكن لم يكن هنالك تقارير عن وجود الأخداد الإضافية (AS) في السطح السفلي للفص الأيمن في الكبد. قد يمثل وجودها دورة عميقية من الأوعية الكبدية السطحية التي تتبّع المزيد من الفاصلة لجراحي الكبد الصفراء. كما أن وجودها قد يكون بسبب النقص المتطور أو مكتسب كنتيجة عن الضغط بواسطة أي تركيبة سطحية. كما يمكن أن تكون المعرفة التشريحية للأخداد الإضافية (AS) مهمة لأطباء الأشعة الذين يقومون بالتصوير المقطعي (CT) للأوعية المخدونة. في هذه الدراسة تم تسلیط الضوء على النتائج التشريحية للأخداد الإضافية (AS) في عيتيتين من الكبد وتطبيقاتها السريرية.

**Objective:** To study the presence of accessory sulcus (AS) in the embalmed cadaveric livers, and compare it with the normal liver.

**Methods:** The present study was conducted on 40 embalmed cadaveric livers in the Department of Anatomy, National University of Malaysia, Kuala Lumpur, Malaysia, from September to October 2007, in order to observe the presence and pattern of anomalous AS.

**Results:** Out of the 40 liver specimens studied, we observed the presence of AS in only 2 specimens (5%). The AS was located in the inferior and posterior surfaces of the right lobes in 2 specimens.

**Conclusion:** The AS of the liver is a rare anomaly. Research studies had mainly described the diaphragmatic sulci in the liver, however there are no research reports on the presence of AS in the inferior surface of the right lobe of the liver. The presence of the AS may represent the deep course of the hepatic veins superficially, thus proving to be more beneficial to the hepatobiliary surgeons. The AS may be due to a developmental defect, or may be acquired as a result of pressure by any superficial structure. The precise anatomical knowledge of the AS may also be important for radiologists interpreting CT images of injected veins. The gross anatomical findings of anomalous AS in 2 liver specimens, and its clinical implications are being highlighted in the present study.

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*From the Department of Anatomy, Faculty of Medicine, National University of Malaysia, Kuala Lumpur, Malaysia.*

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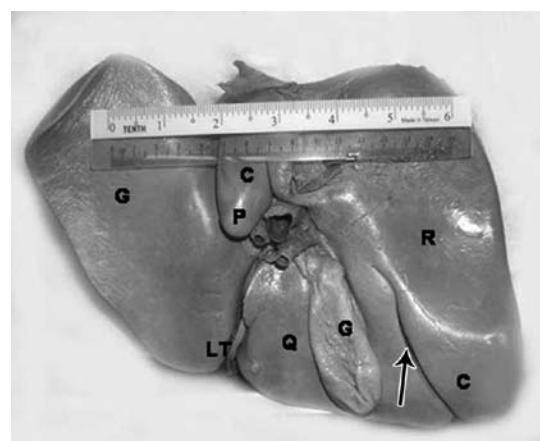
*Address correspondence and reprint request to: Dr. Srijit Das, Lecturer, Department of Anatomy, Faculty of Medicine, National University of Malaysia, Jalan Raja Muda Abdul Aziz, 50300 Kuala Lumpur, Malaysia. Tel. +603 92897263. Fax. +603 26989506. E-mail: das\_srijit23@rediffmail.com*

**A**natomy textbooks have lack of data on the presence of accessory sulcus (AS) of the liver, and the research reports are the only source of information. The incidence of the AS is more common in autopsy findings.<sup>1</sup> The AS are reported to be more common in females.<sup>2</sup> In fact, the higher incidence of the AS in autopsy findings have compelled the researchers to ponder over the fact, if they are really related to post mortem artifacts.<sup>3</sup> Perhaps, that is the reason why AS may be important for

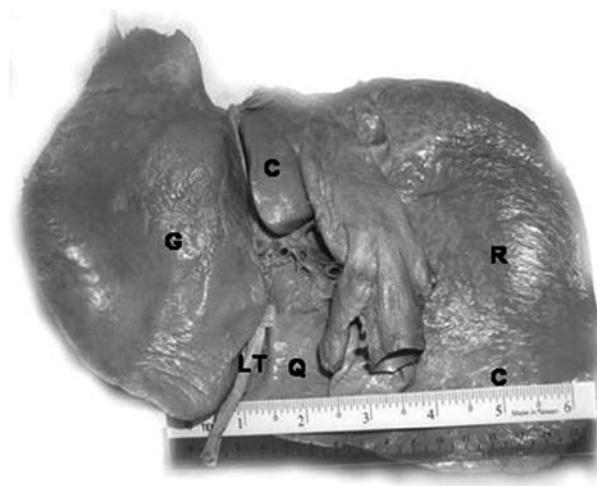
forensic personnel. Accessory sulcus can be incidentally detected during any radiological procedures, routine autopsies, or anatomical dissections. Usually the diaphragm which is related to the superior surface may exert costal pressure to give rise to diaphragmatic sulci (DS). A thorough review of the literature revealed that majority of the DS had been frequently detected during radiological investigations.<sup>4</sup> The DS is located on the diaphragmatic surface of the liver. A high frequency of the DS that are observed during autopsy studies, is attributed to develop from the pressure exerted by the ribs and the diaphragm, and they are usually located on the superficial surface of the liver.<sup>1</sup> Clinicians have opined that the AS or Accessory fissure (AF) may extend deep into the liver thereby mimicking a major sulcus or fissure.<sup>4</sup> This may result in erroneous interpretation of skiagrams. Thus, anatomical knowledge of the AS or AF is important for radiologists in daily clinical practice. The main aim of the present study was to explore the anomalous AS detected in a cadaveric specimen, and discuss its clinical implications.

**Methods.** The study was performed on 40 embalmed human livers from September to October 2007 in the Department of Anatomy, National University of Malaysia, Kuala Lumpur, Malaysia. The cadaveric dissection was performed as per permission given by the institution for teaching and research purpose. The embalmed livers were carefully studied for any presence of AS. Appropriate measurements were taken and the specimens were photographed (Figure 1-3). The course of the hepatic veins were also observed. All intact cadaveric liver were taken for the study. Liver with features of cirrhosis or any damage were excluded. All observations were made on the cadaveric liver while they were used for undergraduate medical students' teaching program. All the measurements were taken by calipers and measuring tape. This was an observational study with no usage of any experimental instruments. The photographs were captured by 5.1 megapixel camera

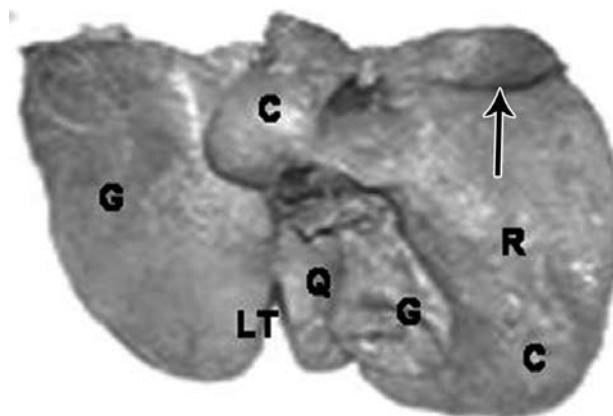
**Results.** Out of 40 embalmed livers, we observed 2 specimens with anomalous AS (5%). In one of the specimens (Figure 1), the AS was located on the inferior surface of the right lobe of the liver. The AS was close to the colic impression on the inferior surface of the right lobe. The AS measured 2.7 cm vertically. In the same specimen, the caudate lobe had a prominent papillary process ('P' in Figure 1). The papillary process projected down towards the groove for ligamentum teres. The anomalous livers with AS were compared to those of the normal liver (Figure 2), and appropriate photographs were taken. In another specimen (Figure 3), we observed the AS to be located on the posterior surface of upper



**Figure 1** - Photograph of anomalous liver showing: G - gastric impression, LT - ligamentum teres, C - caudate lobe, P - papillary process, Q - quadrate lobe, G - gall bladder, C - colic impression, R - renal impression. Accessory sulcus is shown with arrow.



**Figure 2** - Photograph of normal liver (with no accessory sulcus) showing: C - caudate lobe, G - gastric impression, LT - ligamentum teres, Q - quadrate lobe, C - colic impression, R - renal impression.



**Figure 3** - Photograph of anomalous liver showing: C - caudate lobe, G - gastric impression, LT - ligamentum teres, Q - quadrate lobe, G - gall bladder, R - renal impression, C - colic impression. The accessory sulcus is shown with arrow.

part of right lobe. The AS has a horizontal course and it measured 1.5 cm transversely. No other anomalies were observed. The history of the individuals were not available for any of these cases.

**Discussion.** Earlier research reports have defined the presence of the DS on the superficial aspect of hepatic parenchyma which are considered as weak zones.<sup>2</sup> A research study had also described the relationship between the DS and the superficial part of the portal fissure.<sup>2</sup> On extensive search of literature, we found that few of the authors have described the DS to be located between the right and the anterior surface, with a course and concavity towards the falciform ligament, thereby corresponding to 'radial' grooves.<sup>3</sup> A simple hypothesis is accepted that the diaphragm may exert pressure on the weak zones of the liver that may attribute to the formation of these sulci.<sup>2</sup> In our case, we observed the AS to be located on the posterior surface of the upper part of the right lobe of the liver, which is very close to the diaphragm. Perhaps that could have explained of its development in this region, however, the presence of AS near the colic impression, namely, on the inferior surface of the right lobe is an anatomical finding which has not been reported by any author. The pressure exerted by the colon also cannot be ruled out. We admit that the results might have varied in a larger population. The history of the cadaver might be another factor, which could have caused for the development of AS, and admittedly we did not have such. The development of the AS may also be linked to genetic causes.<sup>5,6</sup> It has been reported that the span of activity and shift of growth zones in the liver are dependent on beta-catenin/Wnt activity.<sup>6</sup> In the younger age group, the failure of any genetic guidance may be responsible for development of the sulci.<sup>6</sup>

On dissecting the interior of the liver, it was found that the hepatic veins have a relationship with these sulci. The AS have been described to be located at the boundaries, between the ramifications of the terminal branches of the hepatic veins.<sup>6</sup> The anatomical location of the AS may be beneficial to hepatobiliary surgeons who require the knowledge of hepatic veins. It has been reported that the accessory fissures on the liver are due to invagination of the liver by the diaphragm, and often they resemble the major hepatic fissure on sectional images which make it more difficult to interpret.<sup>4</sup> It is also a reported fact, that only 25% cases may be detected in any CT scans, and often it may be mistaken as pathological nodules of the liver.<sup>4</sup>

Interestingly, if the morphogenesis of the mammalian liver is far from complete at birth, then the chances

of variations existing in post natal life is rare.<sup>7</sup> It has been reported that the anterior fissure of the liver may be regarded as the third door of the liver exposing all the Glissonian pedicles.<sup>8</sup> Considering the fact that the fissures corresponds to the ramifications of the portal vein liver, a thorough knowledge would be beneficial for surgeons performing resection surgeries.

Accessory sulcus may not be detected unless having any symptoms. A past study had defined the anomalous branching of the intrahepatic portal veins, and a round ligament in a 70-year-old cadaver.<sup>9</sup> The same study had opined that presence of variations in the liver may cause complications during any transplantation surgeries.<sup>9</sup> Undoubtedly, these are incidental findings at autopsy, and they should not be ignored. The presence of AS may mimic any injury to the liver during any post mortem study. The anatomical knowledge of AS may be important for forensic personnel, hepatobiliary surgeons and radiologists in day to day clinical practice. The future studies may incorporate radiological techniques for comparative diagnosis. Radiological studies may help in diagnosing patients with trauma where the linear markings of the injury might resemble as an AS.

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