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COMPARATIVE ANATOMY

Anomalous splenic notches: a cadaveric study with clinical importance

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Abstract: *Objective:* To study the anomalous splenic notches and discuss their clinical importance.
Background: The lobulated form of the spleen in early developmental phase is represented by notches at a later period which occur at the superior border. The superior border which separates the gastric impression from the diaphragmatic surface has notches near its lateral end.
Methods: Considering the fact that there is paucity of literature on the presence of splenic notches, we performed the study on 100 formalin fixed cadaveric spleens to observe the presence of notches.
Results: The notches were observed on the superior and inferior border in ninety eight and two cases, respectively. The anomalous presence of fissures on the diaphragmatic surface was observed in two cases.
Discussion: In view of the observations, we as anatomists feel that standard anatomy textbooks should incorporate the fact that presence of notches is confined not only to superior border but they can also be found in the inferior border. Presence of notches in the inferior border may be important for surgeons attempting splenic surgeries and radiologists interpreting CT scans. In the present study, we discuss the morphological and clinical aspect of anomalous notches and fissures in the spleen *(Tab. 1, Fig. 5, Ref. 10)*. Full Text (Free, PDF) *www.bmj.sk*.
Key words: spleen, anatomy, notch, border, anomaly, variations.

In humans, the spleen is considered to be the largest lymphoid organ. The coelomic epithelium of the dorsal mesogastrium near its cranial end thickens at around the 6th week to give rise to spleen (1, 2). A number of nodules fuse to form a lobulated spleen and the notching of the spleen, observed at the superior border, signifies its multiple nodular origin. In case, the nodules fail to fuse, there is a formation of an accessory spleens. The studies on spleen have increased owing to the immune system with which it is involved.

Topographically, the spleen is located in the left hypochondrium. Normally, the spleen is not palpable but may become palpable when its size enlarges to two or three times the normal. Clinically, the abnormally enlarged spleen is detected by palpating the splenic notch (SN). As per conventional text books of anatomy, the SN is usually present in the superior border with the inferior border being described as blunt (2, 3). A radiologist interpreting a spleen may also evaluate the SN while interpreting the usual CT scans.

The present anatomical study describes the presence of SN on the superior as well as the inferior borders of the spleen with associated anomalous fissures which may have substantial morphological and clinical significance.

Methods

We took 100 cadaveric spleens for the present study. All the specimens were fixed in 10 % formalin. The SN was only observed and no emphasis was paid to other associated anomalies. The SN was carefully studied with regard to its topographical location. Appropriate measurements were taken and the specimens were photographed (Figs 1, 2, 3).

Results

Out of the 100 specimens studied, 98 specimens exhibited SN in the superior border (98 %). The inferior border displayed SN in 2 specimens (2 %). Interestingly, one specimen did not exhibit SN on the superior border, rather the SN was observed at the inferior border (Fig. 1A). We also observed fissures which continued from the notches in 2 % cases (Fig. 3). These fissures were observed on the diaphragmatic surface (shown with arrows in Fig. 3). A notch was also observed at the intermediate border in 2 specimens (shown as encircled area in Fig. 2). The average number of SN on the superior border of all spleens varied between 2–4. A single specimen exhibited 4 notches (Fig. 4). The average vertical length of the spleens was 8 cm.

The results obtained are shown in Table 1.

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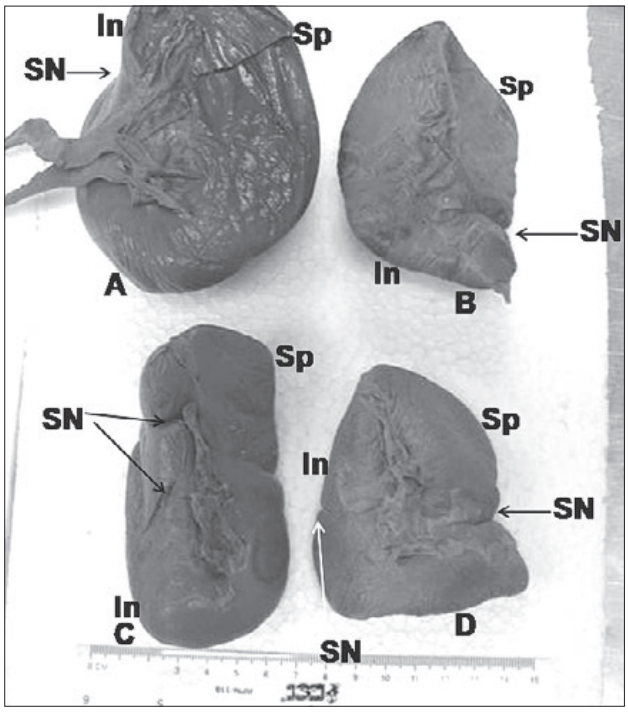

Fig. 1. Photograph showing: A – spleen with no notches on the superior border, B – spleen with no notches on the inferior border, C – spleen with notches on the superior, intermediate and inferior border (arrow), D – spleen with notches on the superior and inferior border (arrow), SN – splenic notches, Sp – superior border, In – inferior border.

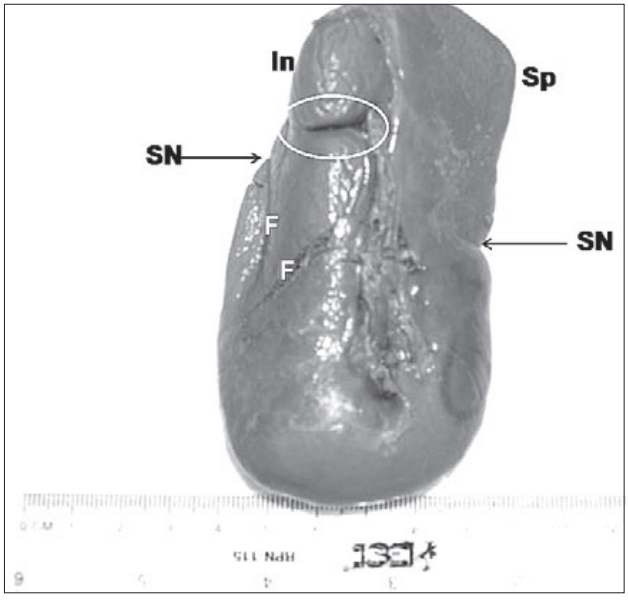

Fig. 2. Photograph showing: Sp – superior border, In – inferior border, SN – splenic notches. The notch on the intermediate border is encircled. F – fissure.

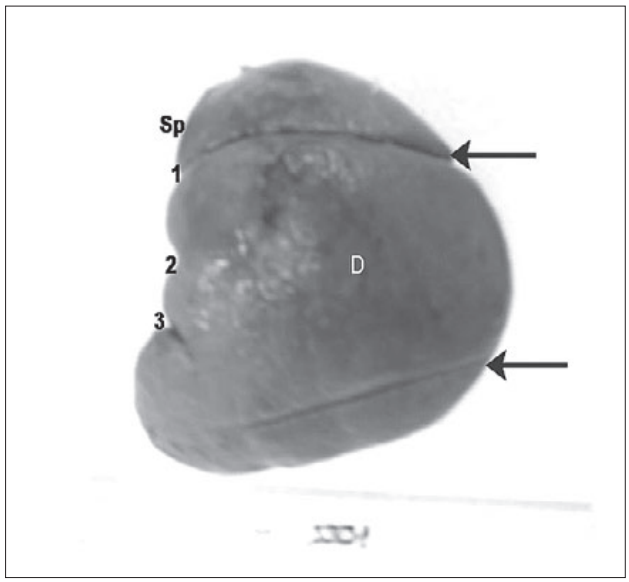

Fig. 3. Photograph of diaphragmatic surface of the spleen showing: Sp – superior border, 1, 2, 3 are the notches on the superior border, D – diaphragmatic surface. Fissures are shown with arrows.

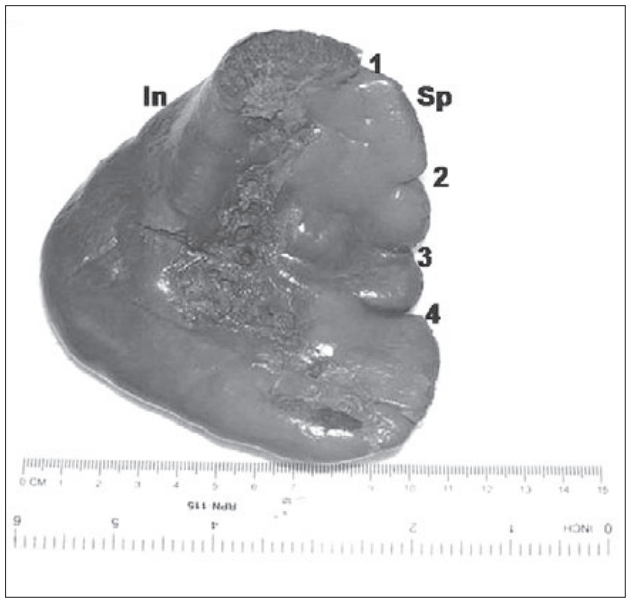

Fig. 4. Photograph showing four notches on the superior border of the spleen. Sp – superior border, 1, 2, 3 and 4 are the notches on the superior border, In – inferior border.

Discussion

Interestingly, till the first half of the twentieth century, the spleen was considered to represent an organ of no special significance (4). Majority of the studies related to spleen have explored its circulatory effects and immune system. The spleen

Tab. 1.

No of specimens with notches only on superior border	98
No of specimens with no SN on superior border	1
No of specimens with notches only on the inferior border and the presence of fissures	2

N.B: There were 2 cases of SN on the inferior border of which one had no SN on the superior border and the other had SN on both, superior and inferior border.

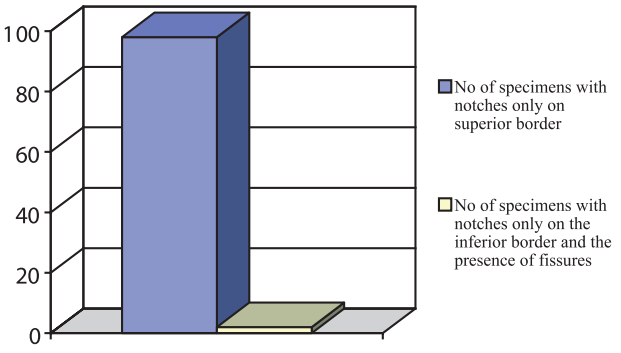

Fig. 5.

has been studied in detail in various conditions ranging from its innervation to diseases like hairy cell leukemia (1, 5). The spleen develops from the splenic buds and the notches represent the lobulation during the fetal developmental period. The notches on the superior border may have clinical significance as this is the portion which a clinician usually palpates in an enlarged spleen.

All parameters of the liver and spleen may be important for ultrasound examination (5). Organ dimension have been also linked to weight of the individual (5). Anomalies of the spleen often remain undetected as they are asymptomatic. Cadaveric studies are very important because of discussing any anomaly with which the physician may deal. We as anatomists, opine that an absence of the SN on the superior border, may result in difficulty for any clinician to palpate the spleen.

An extensive review of the literature revealed the incidence of the SN in the superior border in 78.6 %, 70 % and 95 % cases, respectively (6, 7, 8). In the present study, we observed the SN on the superior border in 98 % cases which makes it more frequent as compared to past studies. The previous studies had been performed in the American and the Turkish continent but our study had focused on the Malaysian population and a higher frequency of SN on the superior border may be explained by a geographical difference in pattern which needs to be explored.

Perhaps, the most important finding is the presence of the SN on the inferior border. In the present study, 2 % cases had SN on its inferior border which is an important fact. Interestingly, these 2 cases had the presence of fissures on its diaphragmatic surface which is a rare entity. A past studies had described that in 93 % cases, there might be a presence of two notches in the superior border (Fig. 4) but we observed a maximum number of four notches on the superior border which is a rare finding (9). In fact, according to past studies, the more number of notches in the superior border, the rarer is the specimen (10).

The inferior border has been reported to have the SN in the frequency of 32 % but a smaller incidence as seen in our study clearly states that SN may also be observed on the inferior border (9). We also observed a single specimen to have absence of SN on the superior border (Fig. 1A) which is also a rare finding.

The spleen is less notched in anthropoids but more common in lower monkeys and lemurs (10). Even the carnivores have been found to have SN on all its borders and some animals like the ox, sheep, goat and horse have been found to display no notches (10). The notches or fissures may developed as a result of lobulation in the early developmental phase or may be developed as a result of any external mechanical pressure exerted by the surrounding structures while the spleen was in its phase of growth.

The incidence of the fissures has been reported to be 7.8 % with the mean number being one on the diaphragmatic surface of foetal spleens (8). In the present study, we observed a single specimen to have two fissures (as seen in Fig. 3) on the diaphragmatic surface, which may be considered rare. The fissures on the diaphragmatic surface in two specimens which may be due to a developmental defect or linked to any mechanical pressure of the surrounding structures. Admittedly, the history of the individuals was not known to corroborate the fact. The presence of such fissures may mimic an injury or even cause erroneous interpretation of radiological investigations.

The unnotched spleens are a feature of Rodentia (10). It is rare for any human spleen to be unnotched. It has been explained that the flesh eating animals have a larger spleen than the vegetable eating feeders and notching is also correlated to the increased size of the organ (10) but we refute this earlier view of the earlier scientist with the findings of a large spleen with a single notch. In our study, one specimen with vertical dimension of 14 cm exhibited a single notch on the superior border while another specimen with vertical dimension of 12.5 cm exhibited four notches on the superior border (Fig. 4) which is an interesting finding. The notches that had been described to be linked to growth of the organ is a scientific fact which needs to be reconsidered.

Conclusion

The presence of the fissures and the abnormal notches in spleen are important for any clinical or radiological investigation and also important for anthropological studies. Based on our findings, we opine that anomalies of SN may not be uncommon but its lower incidence on the inferior border may be kept in mind. The presence of fissures may mimic an injury mark on the spleen. The normal limits of the liver, spleen and the kidney are considered as important parameters during any ultrasound examination (5). Based on the results of the present study, we

also feel that there is a need to incorporate the fact in standard textbooks that anomalous fissures and notches do exist in other areas like inferior and intermediate border of the spleen.

References

1. Sadler TW (Ed). Langman's Medical Embryology. Baltimore; Lippincott Williams & Wilkins, 2000: 277.

2. Standring S (Ed). Gray's Anatomy. The Anatomical Basis of Clinical Practice. New York; Elsevier Churchill Livingstone, 2005: 1239—1244.

3. Rosse C, Gaddum R (Eds). Hollinshead's Textbook of Anatomy. Philadelphia; Lippincott-Raven, 1997: 556.

4. Jakubovsky J, Porubsky J. Functional morphology of the spleen. The current knowledge. Bratisl Lek Listy 1995; 96: 637—641.

5. Safak AA, Simsek E, Bahcebasi T. Sonographic Assessment of the Normal Limits and Percentile Curves of Liver, Spleen, and Kidney Dimensions in Healthy School-Aged Children. J Ultrasound Med 2005; 24; 1359—1364.

6. Skandalakis P, Colborn GL, Skandalakis LJ, Richardson DD, Mitchell WE, Skandalakis JE. The surgical anatomy of the spleen. Surg Clin North Amer 1993; 73: 747—767.

7. Soyluo•lu AÝ, Tanyeli E, Marur T, Ertem AD, Özku• K, Akkýn SM. Splenic artery and relation between the tail of the pancreas and spleen in a surgical anatomical view. Karadeniz Týp Dergisi 1996; 9: 103—107.

8. Üngör Bahadýr, Ali Malas M, Sulak O, Albay S. Development of spleen during the fetal period. Surg Radiol Anat 2007; 29: 543—550.

9. Bergman RA, Afifi AK, Miyauchi R. Virtual hospital illustrated encyclopedia of human anatomic variation: opus IV: organ systems: digestive system and spleen 2006.

10. Parsons FJ. Notches and fissures of the spleen. Anat Physiol 1901; 35: 416—427.

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