Original Article

Accessory Spleen: Prevalence and Multidetector CT Appearance

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Submitted: 2 Sep 2013
Accepted: 10 Apr 2014

Abstract

Background: **The aim of this study was to evaluate the prevalence and computed tomography (CT) appearances of accessory spleens in hospital-based patients, and to measure and make comparisons between accessory spleen size and density.**

Methods: **A cross-sectional study was carried out in a diagnostic center in Erbil, Iraq during January–December, 2012. Biphasic abdominal CT images of 334 consecutive patients with different age groups were evaluated for the presence of an accessory spleen, and if identified, it was further analysed for shape, diameter, density, number, and location. Patients with inadequate CT techniques, splenectomy, hematological disorders, and widespread lesions in the abdomen were excluded from this study.**

Results: **Of the 334 patients (198 female, 136 male), with a mean age of 47.2 years (SD 15.7), 82 accessory spleens were detected in 63 patients (18.8%). Their mean diameter was 14.7 mm (range 3–79 mm), 68% were round in shape and 75.6% were medial to the main spleen. Sixty percent of the cases showed a single accessory spleen and 40% had more than one (up to 4 detected). A significant difference in the mean diameter of accessory spleens between similar and different densities than the main spleen was observed (P = 0.018), 71 accessory spleens (mean diameter = 15.97 mm) displayed similar densities to the main spleen, while 11 (mean diameter = 7.09 mm) were hypodense or hyperdense to the main spleen.**

Conclusions: **The prevalence of an accessory spleen is high, and should be considered by radiologists during abdominal CT scan reporting.**

Keywords: *prevalence, spleen, multi-detector Computed Tomography*

Introduction

The capability of imaging the spleen has been limited in the past to nuclear scintigraphy and angiography as the traditional means. Computed tomography (CT), and to lesser extent, ultrasonography have become the modalities of choice for splenic imaging. The CT is excellent at showing a wide variety of splenic variations and abnormalities, while simultaneously allowing evaluation of the remaining intra-abdominal structures (1).

Ectopic splenic tissue can be categorised as one of two entities: splenosis that is due to autotransplantation of splenic tissue, which usually happens after splenectomy and trauma; and accessory spleens that are congenital foci of healthy splenic tissue, which are separate from the main body of the spleen (2).

The accessory spleen represents one of the splenic variations that is relatively common, with an autopsy incidence of 10–30%, and they are clinically important in some patients (3,4). Therefore, knowledge about their CT appearance is required to avoid pitfalls in the interpretation of abdominal imaging studies (5).

To the best of our best knowledge, no local study exists recording the CT prevalence of accessory spleens. Only two prior studies have described the CT features of the accessory spleen, and one of them used thick collimation CT sections. Therefore, the aim of this study was to determine the prevalence of accessory spleens based on CT appearance, and to compare the mean diameter between the accessory spleens with similar and different densities in a hospital based sample in Erbil, Iraq during the period from January–December of 2012. This was to determine the multidetector CT appearances of accessory spleens, to record whether overcoming the technical limitation of the previous studies can change the previously recorded features, and to add new findings concerning accessory spleen appearances, such as a different prevalence in a different population group, and unexpected shape, size, number and location.

Materials and Methods

Study group

During a one-year period (January, 2012 until December, 2012), 1247 consecutive abdominal CT scans were performed at a diagnostic center in Erbil, Iraq, where the patients were referred for various surgical and medical indications. The abdominal CT scans of these 1247 patients of different age groups were reviewed for the presence or absence of an accessory spleen, and further analysis of its appearance was performed if an accessory spleen was identified.

In order to confirm whether the identified and analysed structure is an accessory spleen, cases presumed to have an accessory spleen were subjected to a comparison of their CT scans with a prior scan or a follow up scan performed during the study period. Stability of the size, site, number and shape of the presumed accessory spleens was the criteria we based our study upon to verify our data; failure to achieve such a comparison was one of the exclusion criteria in our study.

To differentiate an accessory spleen from the nearby bowel loops, a comparison with different phases of CT studies was made (e.g. plain with contrast enhanced phases) since the bowel loop could change shape, size, and location in different phases of the scan. Patients with inadequate CT techniques (such as a native scan only), cases with splenectomy, hematological disorders or widespread lesions in the abdomen interfering with the detection of an accessory spleen were also excluded from the study. After the exclusion of the patients with the aforementioned criteria, the final study group was comprised of 334 patients.

Institutional ethical review board approval from the College of Medicine/Hawler Medical University was obtained, and informed patient consent was waived.

CT techniques and imaging parameters

All CT examinations were performed using a multidetector 16-row Somatom Emotion, Siemens CT scanner (Erlangen, Germany), with 0.6 seconds of gantry rotation time. The patients received an injection of 100–120 mL of iohexol (Omnipaque™, GE Healthcare) at 350 mg through 20–21 gauge peripheral venous access, at a flow rate of 3.5–4 mL/sec.

Each CT examination was performed with a biphasic helical CT protocol that included an arterial phase for the upper abdomen, followed by a portovenous phase for the whole abdomen and pelvis using a high spatial resolution protocol (16 × 0.6 mm collimation, 5 mm section thickness, 0.7 mm reconstruction interval, 1–1.3 mm per rotation table feed, 120 mAs and 130 kVp). A standard delay of 30 and 80 seconds for the arterial and portovenous phases was applied in all patients, respectively, using a bolus injection technique to administer the contrast materials with an automated injector (MEDRAD Vistron CT).

The multidetector row CT data obtained were reconstructed with a standard soft algorithm at a 0.75 mm reconstruction interval, with 5 mm thick CT images of 5 mm intervals for multiplanar reconstruction (MPR).

Image analysis

The CT scans of the enrolled patients were evaluated by two readers with different degrees of experience in abdominal CT scan interpretation. The analysis was made at the same setting, but each reader was blind to the results of the other, while discrepancies were resolved by consensus. The scans were first assessed by scrolling the images on a dedicated double monitor workstation (SIMOMED) using three planes (axial, coronal, and sagittal planes), followed by an evaluation of the scan for the presence or absence of accessory spleens, and the shape, maximum diameter, total number per patient, density, and location in relation to the main spleen.

The shape of the accessory spleen was recorded as round, ovoid, triangular or others . The maximum diameter (in mm) was measured using an electronic caliper measurement on a soft copy workstation. Additionally, the density measurement was performed during the portovenous phase of the scans, when the splenic tissue displayed a homogeneous enhancement pattern, and the measurements were taken using a mean Hounsefield (HU) of a circular region of interest (ROI) placed at the center of the accessory spleen. The diameter of each ROI was set to not exceed half of the diameter of the identified accessory spleen (not to reach the margin of the accessory spleen) in order to avoid the partial volume averaging from the nearby structures. Additional circular ROI density measurements of similar size were drawn for the main spleen to make comparisons between each identified accessory spleen and the main spleen.

The density of the accessory spleen was classified as: same density, lower density (hypodense) or higher density (hyperdense) to the main spleen, using a difference of more than 5 HU as a point below or above to be considered as hypo or hyper-dense to the main spleen.

The location of the accessory spleen was

classified as anterior, posterior, medial, lateral, superior or inferior, relative to the main spleen.

Statistical analysis

The data were entered and analysed using the Statistical Package for Social Sciences (SPSS Version 19). We used frequency and percentages to describe the proportion of patients having accessory spleens; while the mean and SD were used to summarise and describe the numerical variables like the accessory spleen diameter. The student's *t* test of two independent samples was used to show whether there was a significant difference between the mean diameter of the accessory spleens having the same density as the main spleen, and with the mean diameter of the accessory spleens having lower or higher density than the main spleen. The one way analysis of variance (ANOVA) was used to compare between the means of more than two samples (mean diameter of accessory spleens by location), and a *P* value of less than 0.05 was considered to be statistically significant.

Results

Three hundred and thirty four patients (198 female and 136 male) with a mean age of 47.18 years (SD 15.75), ranging from 13–82 years, were included in this study. Out of 334 cases, 82 accessory spleens were detected in 63 patients (18.8%). Fifty-six accessory spleens (68.3%) were of round shape, 20 accessory spleens (24.4%) were oval in shape, 5 (6.1%) were triangular, and only one single accessory spleen (1.2%) was heart shaped (Figure 1a). The maximum diameter range was 3–79 mm, with a mean diameter of 14.7 mm (SD 11.72) (Figure 1a).

With regard to the number of accessory spleens, 49 patients (59.8%) had only a single accessory spleen and 33 patients (40.2%) had more than one accessory spleen (one patient displayed 4 accessory spleens). A significant difference in the mean diameter of the accessory spleens between similar and different densities as the main spleen was observed (P = 0.018) (Table 1).

Of the detected accessory spleens, 71 (86.6%) had the same CT attenuation value as the main spleen, 10 (12.2%) were hypodense to the main spleen, where all were equal or less than 7 mm in their maximum diameter (except two with diameters of 12 and 16 mm, respectively), and one accessory spleen (1.2%) had a CT attenuation value slightly higher than the main spleen, where it again displayed a diameter of 7 mm.

The majority of accessory spleens (75.6%) were medial to the main spleen, followed by 7.3% for the anterior location, 6.1% were laterally located, and each of the posterior, superior (Figure 1b, Figure 2a, 2b) and inferior locations had a similar percentage of locations (3.7%) (Table 2). No significant difference between the mean of the

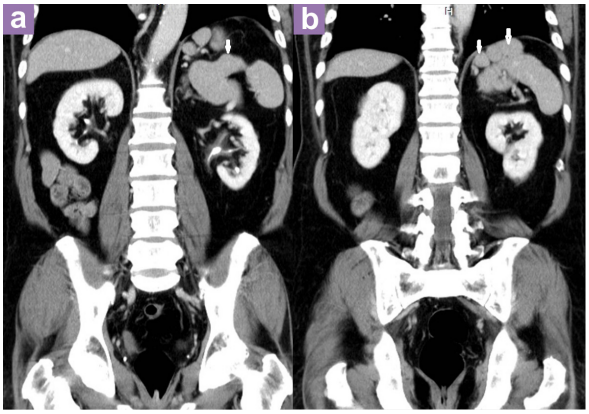

Figure 1: Coronal contrast enhanced computed tomography image in a middle-aged man (a) shows a large accessory spleen (white arrow) measuring 79 mm in diameter, of heart shaped configuration. (b) More anterior section of the same patient shows two large accessory spleens (white arrows) superior to the main spleen.

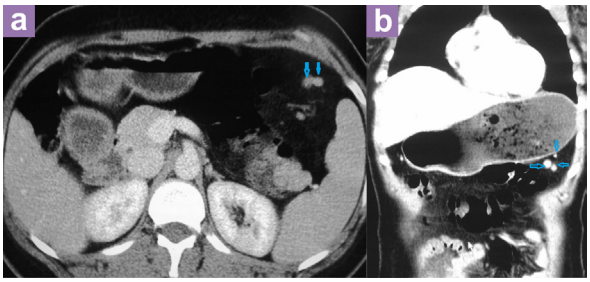

Figure 2: Contrast enhanced computed tomography image (a) axial section showing two small accessory spleens (blue arrows) anterior to the main spleen. (b) Coronal section of the same patient showing three small accessory spleens (blue arrows) in a more anterior plane than the main spleen, located inferior to the greater curvature of the stomach.

diameter and the location of the accessory spleens was observed (*P* value = 0.789) (Table 2).

Discussion

The spleen is included and well demonstrated on every abdominal CT scan, and it is often included in the chest CT scanning (6). Its attenuation is 40–60 Hounsfield Units (HU); being (5–10 HU) lower than the liver density in an unenhanced scan. It shows heterogeneous (arciform) enhancement during the first minute after a bolus injection of contrast due to different blood flow rates through the cords of the red and white pulp. This heterogeneous enhancement resolves in the portovenous phase of enhancement (4,7).

An accessory spleen is also known as a supernumerary spleen, splenunculi or splenule, is congenital foci of healthy splenic tissues that are found apart from the main body of the spleen (8). Since a CT scan is the imaging technique most commonly used to evaluate the abdomen and pelvis, familiarity with the CT features of an accessory spleen are required to avoid pitfalls in the interpretation of abdominal imaging (3,5).

Although an accessory spleen is usually asymptomatic and incidentally discovered (3), its clinical significance falls into three clinical scenarios. First, the accessory spleen can undergo hypertrophy after splenectomy, and is responsible for the recurrence of hematological disorders for which the splenectomy has been performed (idiopathic thrombocytopenia, hereditary spherocytosis, acquired autoimmune hemolytic anemia and hypersplenism) (7). Thus all accessory spleens should be removed during splenectomy for blood dyscrasia, and a surgeon's awareness of their presence will be important when the intention is to remove all functional splenic tissue (3,5).

Second, during medical imaging, an accessory spleen may be confused with an enlarged lymph node or neoplastic growth in the tail of the pancreas, gastrointestinal tract, kidney, adrenal gland or gonads (9).

Third, an accessory spleen may occasionally become symptomatic because of torsion, spontaneous rupture, hemorrhage or cyst formation (3,10,11), and can cause an acute abdomen associated with an intraperitoneal inflammatory mass.

For the aforementioned reasons, a familiarity with the prevalence and CT appearances of an accessory spleen is important, and to the best of our knowledge, only limited data are available

Table 1: The mean comparison of the accessory spleen diameters based on CT density

Density of the Accessory Spleens	Numbers of Accessory spleens	Mean diameter (mm)	SD	*P*
Same density as the main spleen	71	15.97	12.10	0.018
Hpodense or hyperdense to the main spleen	11	7.09	3.78	

Table 2: Location frequency of the accessory spleens relative to the main spleen, and their relationship to the size of the accessory spleen

Location of accessory spleens relative to the main spleen	Numbers of Accessory spleens (%)	Mean diameter (mm)	SD	*P*
Medial	62 (75.6)	15.50	12.88	0.789
Lateral	5 (6.1)	11.60	5.03	
anterior	6 (7.3)	9.00	4.90	
Posterior	3 (3.7)	12.00	5.20	
Superior	3 (3.7)	16.67	5.69	
Inferior	3 (3.7)	17.67	12.90	
Total	82 (100)	14.78	11.73	

studying these features. Therefore, we attempted to study these criteria and cover some limitations of the previous studies by using a higher slice multidetector CT scanner, thinner collimation and including the pelvic region in the scan field.

Our data show that accessory spleens are present in 18.8% of patients undergoing abdominal CT scanning, while Mortele et al. (3) and Romer et al. (12) revealed 16% and 11.5% CT prevalence, which are slightly lower than in our study. This may be attributed to the use of a high resolution CT technique or different population group.

Since 18.8% CT prevalence of accessory spleens in the present study is still within the range of 10–30% autopsy prevalence (3), it indicates the high accuracy of multidetector CT scanning in determining the presence or absence of accessory splenic tissue, on which the surgeon can rely before performing splenectomy for hematological disorders.

Mortele et al. (3) and Romer et al. (12) showed maximums of three accessory spleens per patient, with maximum diameters of 24 mm and 32 mm, respectively. In their studies, the shape of the accessory spleens varied from round, oval to triangular. One patient in our study showed four accessory spleens, the largest one measuring 79 mm at its maximum diameter, while one had a heart shaped configuration. This single patient has added additional features to the previous two studies concerning the number, shape and maximum diameter, although accessory spleens with a mean size of 14.7 mm and 68.3% round configuration in our study are still comparable to the results of Mortele et al. (3) (16.8 mm mean size, round shape 78%) and Romer et al. (12) (10.3 mm mean size, round shape 80%).

A minimum diameter of 3 mm for the accessory spleens observed during our study is in agreement with Romer et al. (12) who reported the same minimum dimension, while Mortele et al. (3) reported a 4 mm minimum dimension, which may be explained by using thinner slice collimation, multiplaner reconstruction and electronic caliper measurements on soft copy images.

The density of the detected accessory spleens was parallel to that of the main spleen in all but 12.2%, where they were slightly lower in density than the main spleen. This is mostly due to the partial volume effect, as the majority of these accessory spleens that were of lower density had diameters of 7 mm or less.

We observed that the most common location of the accessory spleen relative to the main spleen was the medial location, with a record of 75.6%, followed by the anterior location (7.3%), lateral position (6%), and 3.7% for each of the superior, inferior and posterior locations. Mortele et al. (3) reported no accessory spleens superior to the main spleen, and this area was not tackled by Romer et al. (12), which (again) may be explained by the added effect of multiplanar reformatting, or may be due to the different population groups in each study.

No intrapancreatic or pelvic accessory spleens were detected in the present study, which may be due to the small patient sample when compared with Mortele et al. (3), who reported two intrapancreatic accessory spleens in a sample of 1000 patients. However, Romer et al. (12) reported no intrapancreatic accessory spleens in a sample of 1735 patients. Although one out of six accessory spleens occurs in the pancreatic tail (13), neither our study nor the previous two studies confirmed this fact. However, radiologists should be aware that a subtle pancreatic tail lesion could be an intrapancreatic accessory spleen, a high index of suspicion will lead to correlative imaging, and a combination of CT, magnetic resonance imaging (MRI) and nuclear medicine examinations can confirm the diagnosis and prevent unnecessary surgery (13).

Conclusion

In conclusion, an accessory spleen is a common finding, and a CT scan is an accurate means for its identification on which the surgeon can rely when searching for any functioning splenic tissue before performing splenectomy. An awareness of such a common entity is helpful when a mass of almost similar density to the spleen is identified in the left side of the upper abdomen, regardless of shape or size, number or location. Further workup by appropriate radionuclide imaging can avoid surgical exploration or needling the patient.

Further studies are recommended concerning the accessory spleen in the pelvic region, because of the high possibility of misinterpretation as an enlarged Lymph node or other pelvic pathology, for which unnecessary pelvic surgery may be undertaken.

Acknowledgement

Dr Medya Bahaaldin for linguistic revision, Dr Namir Al-Taweel for statistical help and Mr Aman Karim for CT techniqal support.

Conflict of Interest

None.

Funds

None.

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References

1. Freeman JL, Jafri SZ, Robert JL, Mezwa DG, Shirkhoda A. CT of congenital and acquired abnormalities of the spleen. *Radiographic*. 1993; **13(3)**:597–610.

2. Kim SH, Lee JM, Han JK, Lee JY, Kim KW, Cho KC, et al. Intrapancreatic accessory spleen: finding on MR imaging, CT, US and scintigraphy, and the pathology analysis. *Korean J Radiol*. 2008;**9(2)**: 162–174. doi: 10.3348/kjr.2008.9.2.162.

3. Mortele KJ, Mortele B, Silverman SG. CT features of the accessory spleen. *Am J Roentgenol*. 2004;**183 (6)**:1653–1657. doi: 10.2214/ajr.183.6.01831653\.

4. Sohaib SA, Reznek RH. Reticuloendothelial disorders: the spleen. In: Grainger RG, Allison DJ, Adam A, Dixon AK, editors. Diagnostic Imaging, 4th ed. London (LDN): Churchill Livingstone; 2001. p. 1436.

5. Dodds WJ, Taylor AJ, Erickson SJ, Stewart ET, Lawson TL. Radiologic imaging of splenic anomalies. *Am J Roentgenol*. 1990;**155(4)**:805–810. doi: 10. 2214/ajr.155.4.2119113.

6. Gayer G, Zissin R, Apter S, Atar E, Portnoy O, Itzchak Y. CT finding in congenital anomalies of the spleen. *Br J Radiol*. 2001;**74(884)**:767–772. doi: 10.1259/bjr.74.884.740767.

7. Dahnert W. *Radiology review manual*. 7th ed. Baltimore (BA): Lippincott Williams & Wilkins; 2011. p. 703–704.

8. Moore KL. Clinically oriented anatomy, 3rd ed. Baltimore (BA): William & Wilkins; 1992. p. 187.

9. Orlando R, Lumachi F, Lirussi F. Congenital anomalies of the spleen mimicking hematological disorders and solid tumors: a single-center experience of 2650 consecutive diagnostic laproscopies. *Anticancer Research*. 2005;**25(6C)**:4385–4388.

10. Chen CH, Wu HC, Chang CH. An accessory spleen mimics a left adrenal carcinoma. *Med Gen Med*. 2005;**7(2)**:9.

11. Seo T, Ito T, Watanabe Y, Umeda T. Torsion of an accessory spleen presenting as an acute abdomen with an inflammatory mass: US, CT, and MRI findings. *Pediatr Radiol*. 1994;**24(7)**:532–534.

12. Romer T, Wiesner W. The accessory spleen: prevalence and imaging findings in 1,735 consecutive patients examined by multidetector computed tomography. *JBR-BRT*. 2012;**95(2)**:61–65.

13. Spencer LA, Spizarny DL, Williams TR. Imaging features of intrapancreatic accessory spleen. *Br J Radiol*. 2010;**83(992)**:668–673. doi: 10.1259/bjr/ 20308976.