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CASE REPORT

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Accessory spleen mimicking pancreatic tumour: evaluation by ^{99m}Tc-labelled colloid SPECT/CT study. Report of two cases and a review of nuclear medicine methods utility

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The accessory spleen is a common congenital anomaly, typically asymptomatic and harmless to the patient. However, in some clinical cases, this anomaly becomes significant as it can be mistaken for a tumour or lymph node and be missed during a therapeutic splenectomy.

There are nuclear medicine modalities which can be applied in the identification and localisation of an accessory spleen. They include scintigraphy with radiolabelled colloids or heat damaged red blood cells, which are trapped in the splenic tissue. Modern techniques, including hybrid imaging, enable simultaneous structure and tracer distribution evaluations. Additionally, radiation-guided surgery can be used in cases where the accessory spleen, which is usually small (not exceeding 1 cm) and difficult to find among other tissues, has to be removed.

In the study, we would like to present 2 cases of patients in which the malignancy had to be excluded for the reason that the multiple accessory spleens were very closely related to the pancreas. There was a lack of certainty in the multi-phase computed tomography (CT) evaluation; however, this situation was clearly resolved by using the ^{99m}Tc-stannous colloid single photon emission computed tomography/CT study. We would also like to briefly analyse the clinical applications of nuclear medicine in case of an accessory spleen. (Folia Morphol 2015; 74, 4: 532–539)

Key words: accessory spleen, SPECT/CT, radiolabelled colloid, radiolabelled red blood cells, splenosis, radiation guided surgery

INTRODUCTION

The spleen is an intraabdominal, intraperitoneal organ consisting of vascular and lymphoid tissue. It is located in the upper left quadrant of the abdominal cavity, right below the diaphragm, protected by the lower left ribs [8].

The spleen develops from a number of separated foci, which then fuse together to form one single organ. There are multiple congenital anomalies of the spleen including complete agenesis, polysplenia (multiple spleens), accessory spleens (ASs) or persistent lobulation [5, 13].

The presence of an AS is very common, reported in even up to 30% of the population. Its location may vary, but typically it is located close to the "main" spleen. Usually, an anomaly such as this is completely

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asymptomatic and harmless, but in some conditions it can be significant. It is very important to recognise an AS, distinguish it from lymphadenopathy or tumour and locate it prior to a splenectomy in case of autoimmune disorders [5].

We are going to present 2 cases of patients with ASs in whom the correct identification of this anomaly was extremely important. These patients underwent contrast enhanced computed tomography (CT) at the St. John's Cancer Centre in Lublin to exclude distant metastases or intrapancreatic tumour. In both cases, the radiologists were not absolutely sure about the nature of the observed lesions. The problem was solved with the ^{99m}Tc-labelled stannous colloid single photon emission computed tomography (SPECT/CT) study.

SPECT/CT study protocol. In both cases the acquisition was performed 20 min after ^{99m}Tc-stanous colloid intravenous injection. The administrated activity was 185 MBq. A Symbia T16 SPECT/CT (Siemens, Erlangen, Germany) gamma camera was used. The SPECT scan consisted of 64 views (dual head gamma camera), 25 s for each with head movement of 3° between views. Additionally, the low dose CT (130 keV, 40 mAs) was done to provide an attenuation correction and anatomical correlation.

CASE REPORT

Patient 1. 60-year-old female with breast cancer history. She underwent surgery on her right breast (breast conserving therapy) along with axillary lymphadenectomy. Additionally, she underwent chemotherapy and radiotherapy. After the treatment there were no signs of local recurrence or distant metastases, nonetheless, she was admitted to the Radiology Department at St. John's Cancer Centre for routine 3-phase CT study to exclude metastatic disease.

The abdomen scan revealed a suspicious tissue mass linked to the tail of the pancreas which was characterised by significant contrast enhancement. The radiologist was not able to identify the boundary between the pancreas and this mass. It was initially identified as an accessory spleen, but the radiolabelled colloid study was recommended to rule out other aetiologies.

This study was performed according to the protocol presented above.

In the SPECT study, there was only one isolated activity area located below the spleen. In the fused images, there was a round tissue mass corresponding to this area — the AS (Figs. 1, 2).

Moreover, fused SPECT/CT images clearly indicated that there was activity coming from the suspicious tissue mass connected to the pancreatic tail, so the AS was also confirmed (Figs. 3, 4).

Patient 2. 63-year-old female, admitted to the St. John's Cancer Centre Radiology Department for further evaluation due to suspicious tissue mass diagnosed during abdominal CT.

Contrast enhanced study displayed this tissue mass located at the tail of pancreas. Additionally several small AS were found.

In the SPECT images, there was additional activity in the area close to the splenic hilum. In the fused images, this activity was related to the tail of the pancreas and the tissue mass located there; proving it to be intrapancreatic AS (Figs. 5, 6).

One more AS was identified in the SPECT/CT scans (Figs. 7, 8). The additional ASs reported in the primary CT study were not localised, probably due to low SPECT spatial resolution.

Both patients remain under control.

DISCUSSION

The spleen's development begins in the dorsal mesogastrium cranial part in approximately the 6th week of embryologic life. As mention above, the cells' proliferation and infiltration takes place in several adjoining points, which later fuse to form one single organ. This lobulated structure can be observed as spleen margin notches in adulthood, but sometimes more prominent lobulation persists as an anomaly. The AS is formed as an ectopic or separated splenic tissue located anywhere from the point of spleen origin in the midline to its final location in the left hypochondrium [13], but not only.

The ASs (also called 'splenules' or 'splenunculi') can be observed in 10–30% of adults during autopsy and in 15–16% of CT studies. Only 0.2% of patients have more than one AS during a CT [5, 6, 13]. The reported incidence of AS is: 1 AS — 79–86%, 2 ASs 10.5–14% and 3 ASs — 1–10.5% among all individuals with an AS. Unver Dogan et al. [13] reported a total number of 54 ASs in 48 patients during 720 autopsies, 91.6% of the patients had 1 AS. In some cases, there can be as many as 6 ASs, very rarely more [2, 15].

Most often, ASs are located close to the splenic hilum (75%), but can also be found at the tail of the pancreas (16–25%), less frequently in the greater omentum, in the wall of bowel or stomach, mesen-

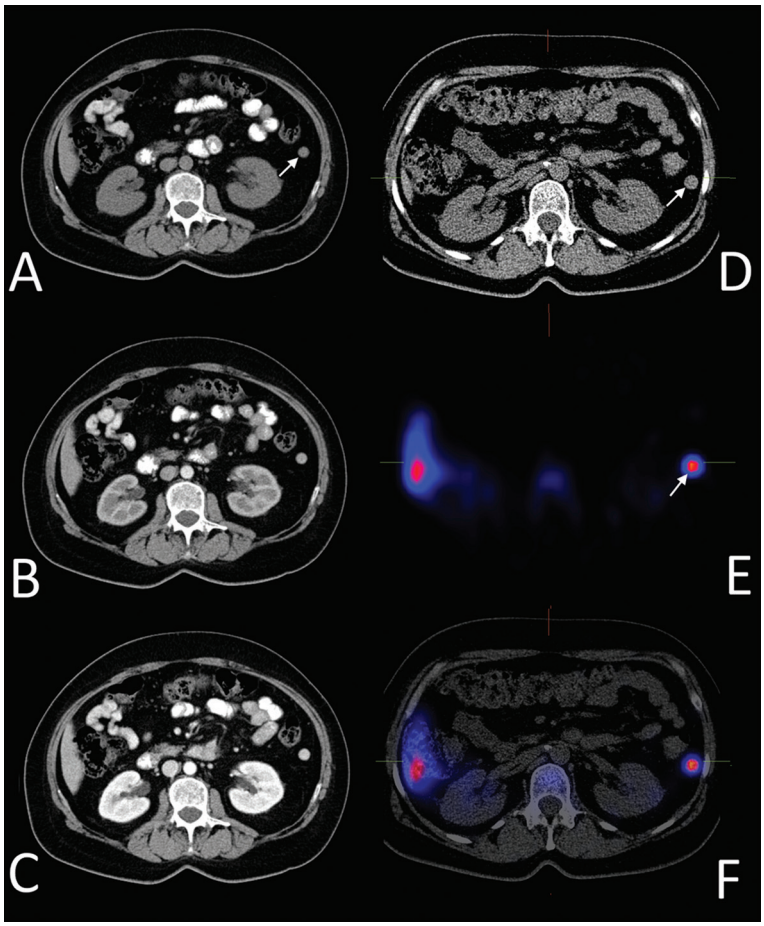

Figure 1. Patient 1. **A, B, C.** Multi-phase computed tomography (CT): pre-contrast, arterial and delayed phases, respectively. Axial scans. Accessory spleen located below the main spleen (arrow); **D, E, F.** Radionuclide study: CT, pure single photon emission computed tomography (SPECT) and fused SPECT/CT images. Axial scans. Radiotracer uptake confirming accessory spleen.

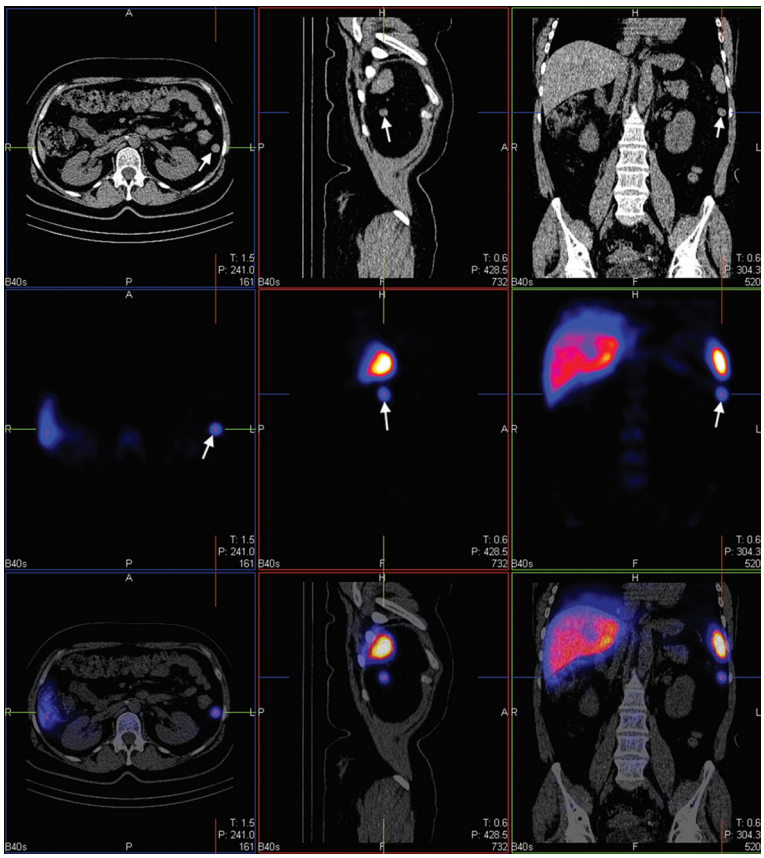

Figure 2. Patient 1. Radionuclide study: computed tomography (CT), pure single photon emission computed tomography (SPECT) and SPECT/CT scans. Axial, sagittal and coronal scans. Accessory spleen located below the "main" spleen (arrow). Also note slight radiotracer uptake in bone morrow of vertebrae.

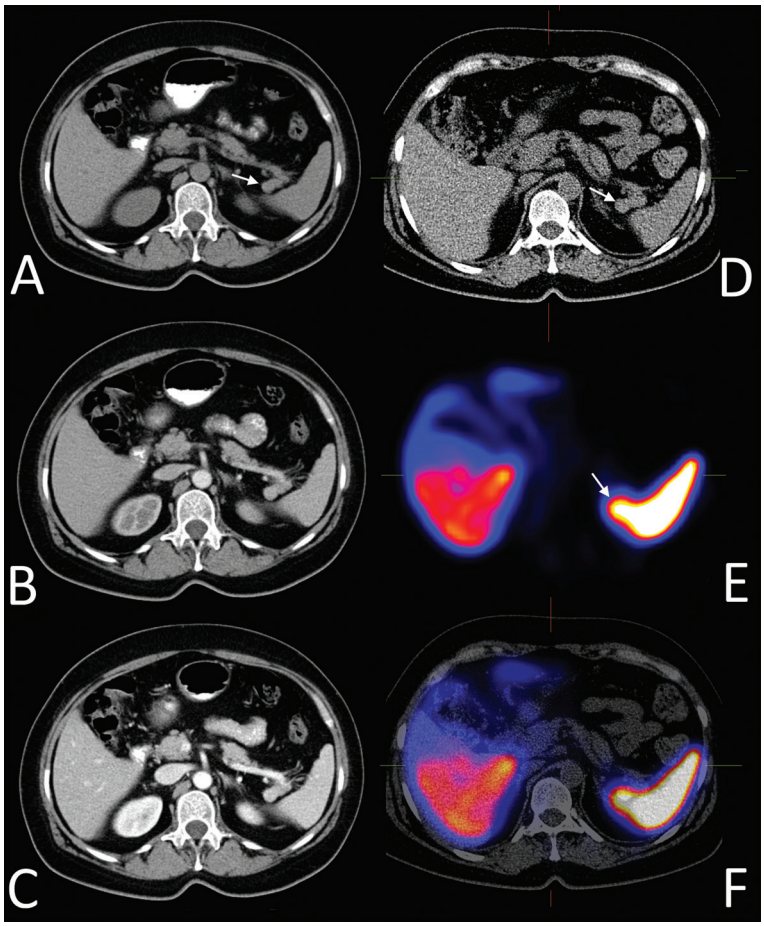

Figure 3. Patient 1. Similarly to Figure 1. **A, B, C, D.** Note radiotracer uptake in both "main" and accessory spleens is indistinguishable in pure single photon emission computed tomography (SPECT) scan (**E**). SPECT/CT fused images (**F**) clearly show the source of activity in the accessory spleen located behind the pancreatic tail (arrow).

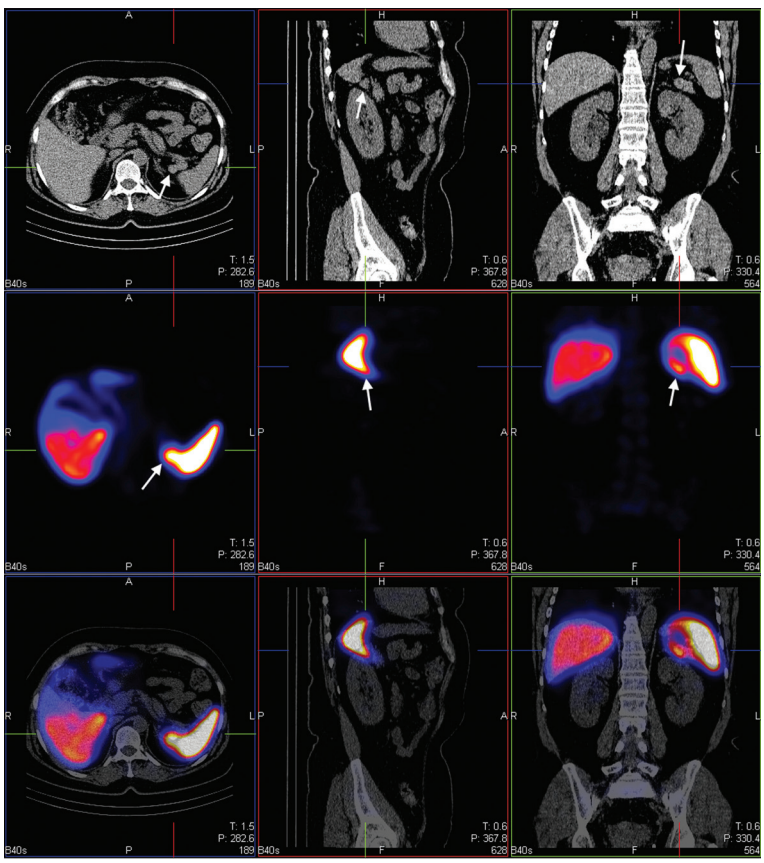

Figure 4. Patient 1. Similarly to Figure 2. In all single photon emission computed tomography scans activity from "main" and accessory spleen merges so the accessory spleen cannot be clearly identified. Fused functional-anatomical images make this identification much easier (arrow). Note also slight activity in the pelvicocalyceal system coming from the radiotracer excreted with urine.

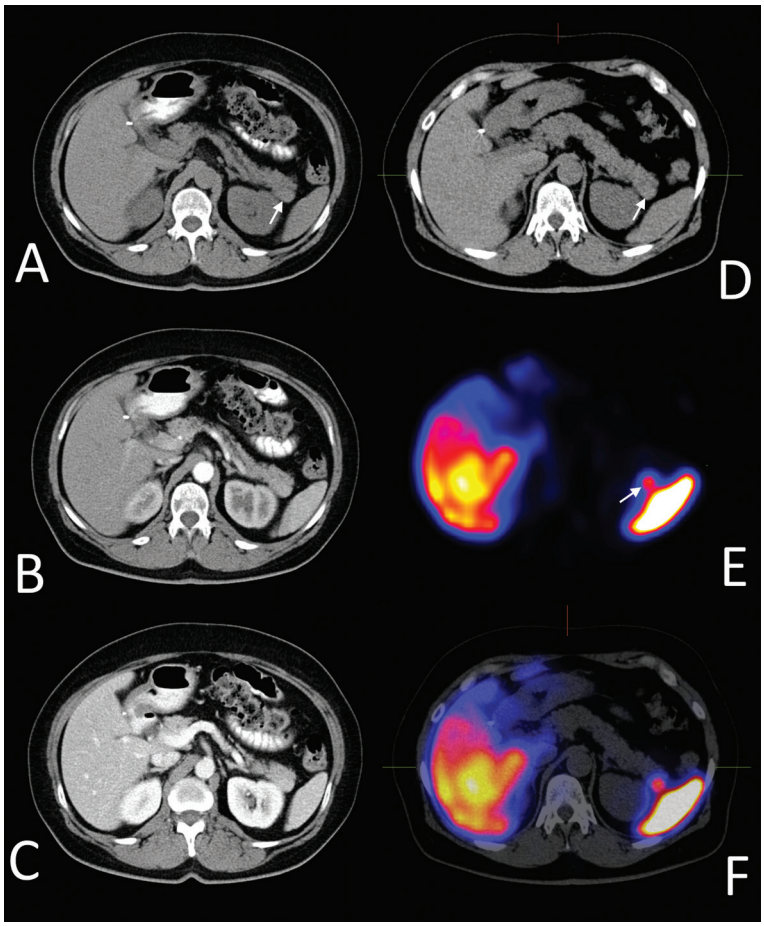

Figure 5. Patient 2. Similarly to Figure 1. The intrapancreatic accessory spleen located in the tail, close to the splenic hilum (arrow).

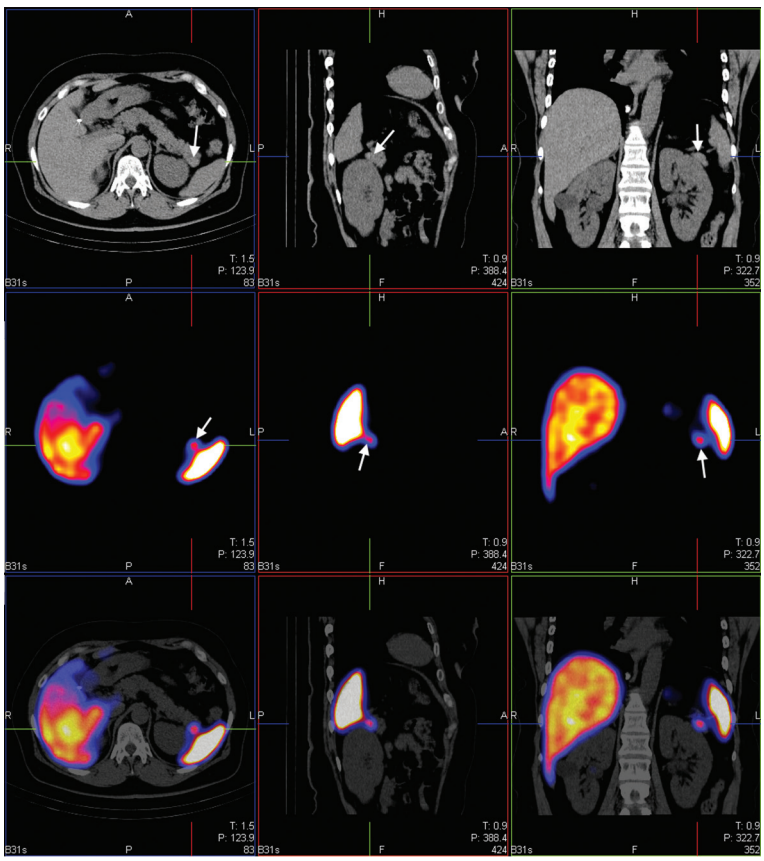

Figure 6. Patient 2. Similarly to Figure 2. The intrapancreatic accessory spleen (arrow).

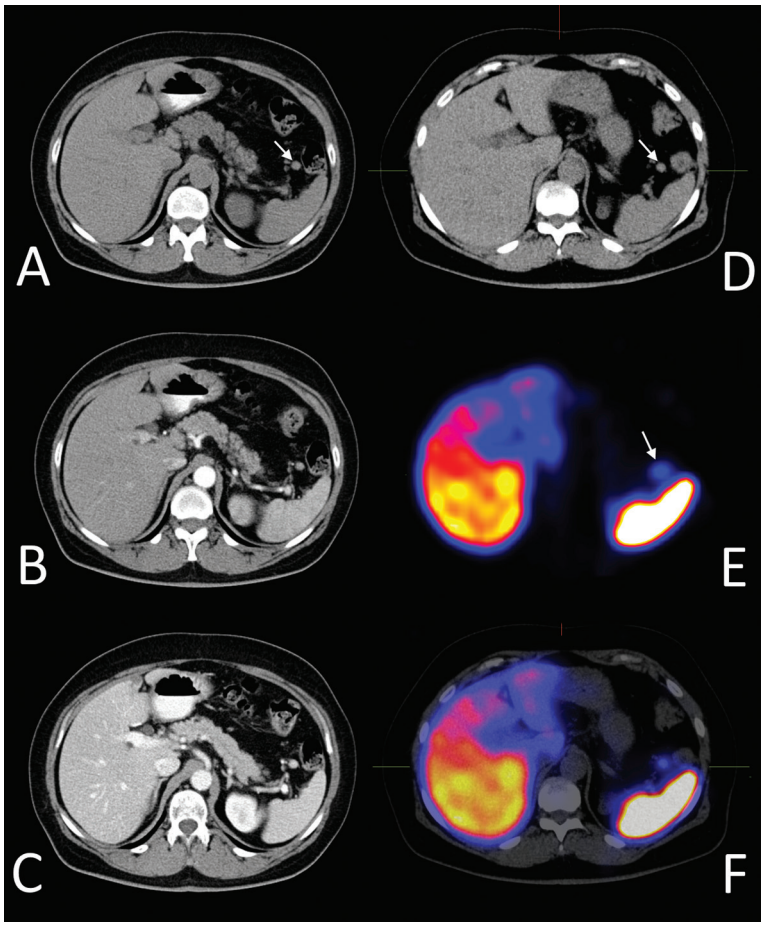

Figure 7. Patient 2. Similarly to Figure 1. One more small accessory spleen indicated by slightly increased activity anteriorly to the "main" spleen (arrow).

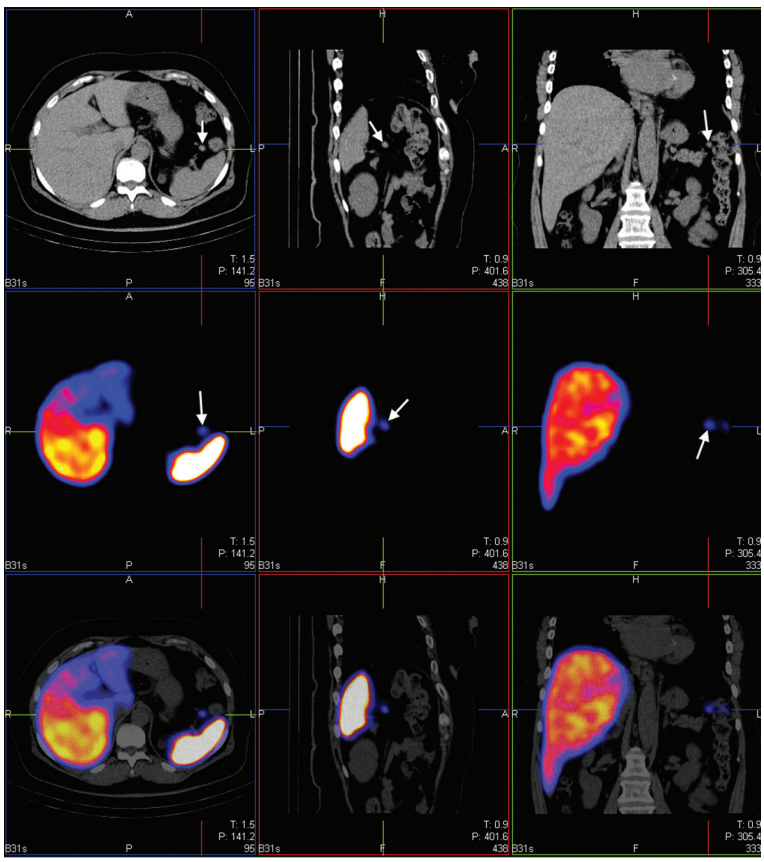

Figure 8. Patient 2. Similarly to Figure 2. The small accessory spleen (arrow).

Table 1. Characteristics of intrapancreatic tissue masses in various diagnostic modalities [7, 10]

Modality	IPAS	Neuroendocrine tumour	Metastases
Contrast-enhanced ultrasonography			
Arterial phase	Hyperechoic to pancreas Isoechoic to spleen	Hyperechoic to pancreas	Usually multiple with heterogeneous enhancement
Portal/delayed phase	Typically prolonged, persistent enhancement	Typically prolonged, persistent enhancement absent	
Computed tomography			
Arterial phase	Heterogeneous enhancement	Small lesions: homogeneous or rim-like enhancement Large lesions: heterogeneous enhancement with necrotic foci	
Portal/delayed phase	Persistently hyperdense to pancreas Isodense to main spleen	Iso- or hypodense, rarely calcifications	
Magnetic resonance imaging			
Precontrast T1 weighted images	Hypointensive to pancreas Isointensive to spleen	Hypo- or isointensive to pancreas	Hypointensive to pancreas
Precontrast T2 weighted images	Hyperintensive to pancreas Usually isointensive to spleen	Hyper- or isointensive to pancreas	Hyper- or hypointensive to pancreas depending on size
Gadolinium enhanced T1 weighted images	Similarly to dynamic computed tomography		
Radionuclide studies			
^{99m}Tc-colloid scintigraphy	Radiotracer uptake **present**	Radiotracer uptake **absent**	Radiotracer uptake **absent**
^{99m}Tc-HDRBC scintigraphy	Radiotracer uptake **present**	Radiotracer uptake **absent**	Radiotracer uptake **absent**
Somatostatin receptor scintigraphy	Radiotracer uptake occasionally present	Radiotracer uptake typically present depending on tumour's character	Radiotracer uptake absent

IPAS — Intrapancreatic accessory spleen; ^{99m}Tc — metastable technetium-99; HDRBC — heat damaged red blood cells

tery, pelvis, broad ligament, left ovary and even the scrotum. Sometimes they can be retroperitoneal. Usually they are small, not exceeding 1 cm in diameter [2, 10, 13, 15].

Normally, AS is a completely asymptomatic condition and is detected accidentally, but in several clinical cases ASs may become significant and tricky to evaluate by the physicians.

The 99m-technetium labelled colloids (sulphur or stannous) injected intravenously are rapidly uptaken by the reticuloendothelial system in the liver and spleen. The colloids are also accumulated in the bone marrow. Modern nuclear medical techniques, mainly the SPECT/CT provide structural data along with radiotracer distribution reflecting the observed structures' molecular behaviour. Such fused functional — SPECT — and anatomical — CT — images are especially helpful since SPECT scans have relatively low spatial resolution. They enable quick AS identification [10, 11].

Alternatively, radiolabelled heat damaged red blood cells (^{99m}Tc-HDRBC) can be used. Since the spleen is responsible for sequestration and destruction of old and damaged erythrocytes, radioactive HDRBC are also quickly trapped by this organ. A similar result can be obtained by using magnetic resonance imaging with ferumoxides [10].

One of the most important clinical cases is the differentiation between the intrapancreatic AS and a pancreatic tumour. In such cases, both nuclear medicine methods can be applied since both colloids and HDRBC are highly specific and activity in the AS can be observed after injection. The metastases must also be excluded when an intrapancreatic lesion is observed. The characteristic appearance of tissue masses related to the pancreas is presented in Table 1 [7, 10].

Groshar et al. [6] evaluated 73 malignancy patients (36 solid tumours and 37 lymphomas) with accessory spleen-like mass (ASLM) by using the fluorine-18-fluorodeoxyglucose (^{18}F-FDG)-positron emission tomography. During the control study, ASLM presented no changes confirming an AS in 69 of the cases. The remaining 4 patients suffered from lymphoma: in 3 patients the ASLM disappeared after chemotherapy indicating an involved lymph node,

1 patient presented an increased FDG uptake reflecting AS involvement [6]. This study strongly suggests that not all ASLM are benign, especially in cases of lymphoma patients. We should be careful.

The second important clinical case involved a patient after splenectomy. In such cases, AS will grow overtaking the removed organ's function, and an unexpected tissue mass can be observed in the abdominal cavity. Recently, Wang et al. [14] reported an AS arising from the gastric fundus mimicking a gastrointestinal stromal tumour. Toutzioris et al. [12] reported compensatory enlargement of the AS mimicking a retroperitoneal tumour.

The possible presence of an AS should be kept in mind during endoscopic ultrasonography. It can also be mistakenly taken as a tumour during this study [2].

One of the most interesting conditions is splenosis, observed sometimes in patients after severe trauma followed by a splenectomy. It is an example of spleen remnants autotransplantation. These disseminated in the abdominal cavity small spleens can mimic multiple metastases. Franceschetto et al. [4] reported a case of suspected hepatocellular cancer metastases where the ^{99m}Tc-sulfur colloid scan confirmed splenosis and spared the patient from more invasive diagnostic procedures. An example of intrathoracic splenosis, also confirmed by colloid scan, was reported by Bhalani et al. [3].

Nuclear medicine methods can also be used in spleen surgery. In some autoimmune disorders splenectomy is a therapeutic procedure and in such cases it is crucial to remove all the spleens. If any of the spleens are missed, the patient's condition will not improve after surgery, or will improve only for a short period of time. In cases of idiopathic thrombocytopoenic purpura, up to 18% of patients have a relapse due to residual or undetected splenic tissue. The surgeon may use a gamma probe to detect the radiation coming from an injected tracer. Such methods are used on a daily basis in departments of nuclear medicine when searching for the sentinel lymph node. This radiation-guided surgery may significantly shorten the operation time, allow for a laparoscopic procedure instead of laparotomy, increase confidence that all ASs have been removed and help avoid another surgery. In such cases HDRBC should be preferred as more specific method than colloids [1, 9].

CONCLUSIONS

Nuclear medicine provides easy, inexpensive, safe and quick spleen identification methods, which can be successfully applied in a variety of clinical cases and can be expanded into the field of surgery.

These diagnostic imaging and radiation guided surgeries should be well-known for physicians since they can be very helpful in proper patient management.

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