Letters to the Editor

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False-Positive and Subsequent False Negative Tc-99m Sestamibi Scan in a Case of Mediastinal Thymoma and Hyperparathyroidism

To the Editor:

Preoperative localization with Tc99m-sestamibi has become an integral step in the preoperative assessment of patients with primary hyperparathyroidism. We examine a case of a patient with hyperparathyroidism who had both a false positive and a subsequent false negative sestamibi scan.

A 62-year-old white male with hyperparathyroidism had a Tc-99m sestamibi scan as part of his evaluation for parathyroid adenoma-hyperplasia. His history was positive for elevated serum calcium of 10 to 12 mg/dL (normal range 8.5–10 mg/dL) and multiple kidney stones. Sestamibi showed no abnormal activity in the region of the neck, but showed increased uptake in the superior mediastinum. CT scan confirmed a 2×1.5 cm nodule (Fig. 1). The patient was taken to the operating room for a right thoracoscopy and excision of ectopic parathyroid adenoma. Intraoperative paprathyroid hormone (PTH) was not done. The patient tolerated the procedure well. Final pathology on the excised tissue was thymoma negative for histochemical staining for PTH.

Postoperatively, the patient continued to have hypercalcemia of 11 mg/dL and an elevated PTH of 106.4 pg/mL (normal range 10–65 pg/mL). A repeat sestamibi scan was performed which did not localize any abnormality (Fig. 2). The patient was taken back to the operating room for bilateral neck exploration. In the operating room a large adenoma was located in the region of the right inferior parathyroid. After removal the intraoperative PTH fell from 131.2 pg/mL to 45.4 pg/mL at 10 minutes by intraoperative PTH. Final pathology of the excised tissue was 440 mg of parathyroid tissue. Postoperatively, the patient's calcium normalized. This case is unusual as the patient had not only a false positive sestamibi scan, but also a false negative study as well. Here we comment on the sensitivity and specificity of sestamibi scans.

Sestamibi is a small protein that is labeled with radiopharmaceutical technetium-99. Sestamibi was initially introduced for cardiac scintigraphy and was later found to be concentrated in parathyroid adenomas. After intravenous injection of the sestamibi-technetium-99, an x-ray is done of the neck that localizes any overactive glands. A second x-ray is then taken 1 to 2 hours post injection. The second film is taken to allow washout of

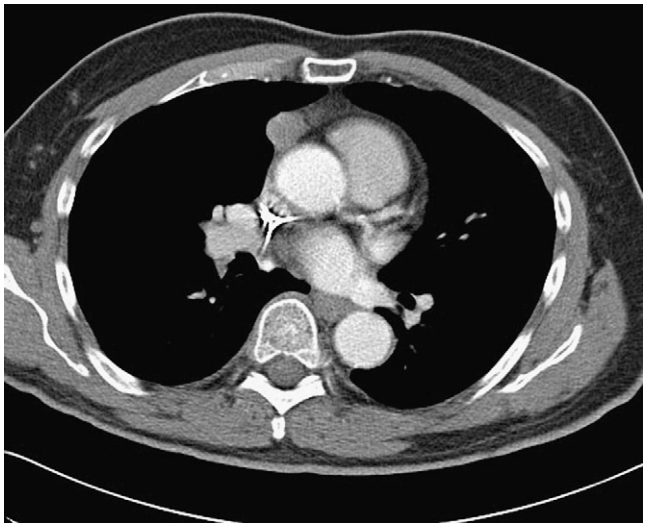

FIG. 1. CT scan of chest done with 100 mL Ominpaque-240 contrast media and 5 mm image cuts. There is a 20×15 mm anterior mediastinal soft tissue mass inferior to the expected position of the thymus and directly right anterior to the ascending aorta.

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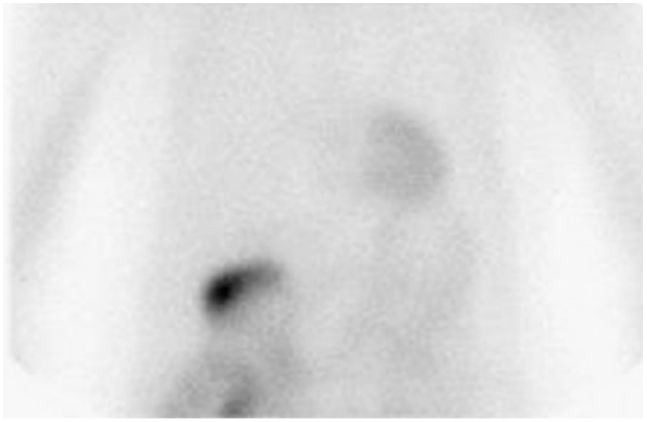

FIG. 2. Parathyroid scan done with Tc Cardiolite 22 mCi to identify possible parathyroid adenoma. There are no abnormal areas of increased activity in the neck or thorax.

Tc-99m sestamibi from the thyroid tissue. Sestamibi washes out of normal thyroid tissue at a more rapid rate than from any parathyroid pathology, thus allowing the localization of abnormal parathyroid tissue.[1]

Although the sestamibi scan is widely used preoperatively to locate parathyroid adenomas, guide neck exploration, and shorten operating time, there remains concern about false positive as well as false negative scans. False positive scans occur when structures other than abnormal parathyroid take up and concentrate technetium Tc99m-labeled radiopharmaceutical. False positive results are often damaging because they can not only result in surgical failure, but also unnecessary invasive surgery with ectopic uptake. False negative scans are perhaps even more common than false positive parathyroid scans. Some of the factors which lead to a false negative scan include ectopic glands and anatomic variations in location as well as low preoperative PTH and low parathyroid weight.[2]

Conventional bilateral neck exploration has a curative success rate of 95 per cent[3] in most series. However, there has been more and more of a shift from standard bilateral neck exploration to focused exploration. It is this shift that makes the sestamibi scan attractive as it can be used in preoperative surgical planning and guide the surgeon in resection of ectopic glands. Moreover, in patients with previous neck surgery preoperative localization is extremely helpful. Presently the sensitivity and positive predictive value of the sestamibi scan is not ideal, falling at 82.1 and 93 per cent,[4] respectively. However, the lack of other adequate imaging makes the sestamibi scan acceptable. It is rare that a case occurs such as ours where both a false positive and a false negative sestamibi transpire.

In conclusion, sestamibi scintigraphy provides the surgeon with a tool to aid in the performance of a direct and focused surgical procedure. This technique often picks up other malignances and its sensitivity is dependent on gland size and concomitant thyroid disease. With the use of intraoperative PTH monitoring and surgeon performed ultrasound, sestamibi scanning has a large role in preoperative localization. Ultimately, however until better preoperative localization tests are developed, there is no substitute for a surgeon experienced in parathyroid surgery.

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Pulmonary Hypertension: An Unusual Presentation of an Iatrogenic Hepatic Arterioportal Fistula and its Successful Resolution Post-Embolotherapy

To the Editor:

Hepatic arterioportal fistulas (APFs) are uncommon clinical conditions with a wide range of causes. The clinical presentation is varied and can be asymptomatic or symptomatic with life-threatening sequelae. We report a case of a rare presentation of a patient with pulmonary hypertension that arose secondary to an iatrogenic cause of hepatic arterioportal fistula.

A 72-year-old Chinese lady presented with a large infected left hepatic lobe cystic lesion measuring 7 cm in diameter. There were no features of portal

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hypertension. Hemihepatectomy was performed using Cusa® (Cavitron Ultrasonic Aspirator) for parenchymal dissection with oversewing of the left portal pedicle intrahepatically with prolene.

A year and a half later, the patient was admitted for congestive cardiac failure. A 2D-echocardiogram done showed moderate pulmonary hypertension (pulmonary artery systolic pressure [PASP] 55 mm Hg). A CT thorax done at that time to investigate this revealed pulmonary arterial enlargement consistent with pulmonary hypertension. In addition, there was a hepatic arterioportal shunt noted. An ultrasound abdomen and Doppler performed revealed high-flow (velocity and volume) direct arterioportal shunt between the remnant left hepatic artery and the remnant left portal vein with arterialisation of the portal venous flow near the site of communication. Mild splenomegaly and moderate amount of ascites not seen on the previous CT scans were also noted. The portal hypertension had led to the development of pulmonary hypertension. The patient was then scheduled for an embolisation of this acquired hepatic arterioportal fistula.

Pre-operatively, a triphasic CT scan of the abdomen (Fig. 1) was done and showed a communication between the remnant left hepatic artery and left branch of the portal vein adjacent to the resection margin. Hepatic artery embolisation was done (Fig. 2): The right common femoral artery was accessed with a 18G needle followed by insertion of a 5F vascular sheath over a guide wire. Using a 5F Cobra catheter the common hepatic artery was catheterized. The left hepatic artery was selectively cannulated using a ProGreat 2.7F microcatheter (Terumo, Somerset, NJ) introduced coaxially via the Cobra catheter. Selective left hepatic angiogram showed a single hole fistula between the remnant eft hepatic artery and left portal vein. A total of five MicroNester platinum microcoils (Cook Medical, Bloomington, IN) (two 14 cm × 8 mm coils, two 14 cm × 6 mm coils, and one 14 cm × 3 mm coil) were deployed at the left hepatic artery proximal to the fistulous communication via the ProGreat microcatheter. Postembolisation arteriogram showed successful obliteration of the arteriovenous shunt (Fig. 2B,C).

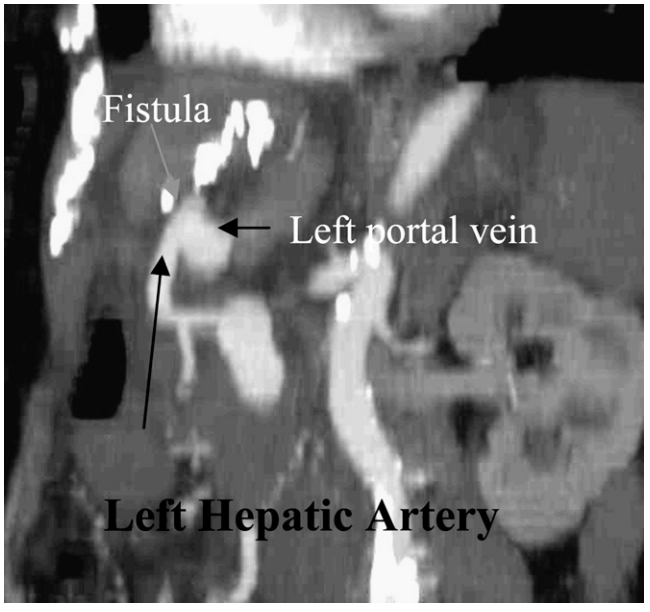

FIG. 1. Sagittal oblique multiplanar reconstruction of hepatic CT angiography showing the APF.

The patient has been followed up with for a period of 6 months and her pulmonary pressures had decreased from 55 mm Hg to 40 mm Hg. There was also complete resolution of her portal hypertension both clinically as well as on the recent CT scans of thorax and abdomen.

Hepatic APF are uncommon clinical conditions that are usually due to either traumatic or iatrogenic causes.[1] With the increased use of angiography and other diagnostic techniques, APF are being reported increasingly and occur in 3.8 to 5.4 per cent of common interventional radiographic procedures.[1] However most of these hepatic APF if small are usually asymptomatic. In this case the APF may have occurred secondary to the acute inflammation from the portal pyelitis that might have occurred after the hemihepatectomy for the liver abscess.

Clinically, patients may present as early as 2 weeks to 2 decades after injuries or interventions.[2] The clinical presentations for these patients are varied and may range from the asymptomatic to life-threatening presentations. Majority of symptomatic patients (80%) present early (usually within 2 years) and complain of hemorrhage, hemobilia, abdominal pain, or diarrhea. Late presentations include signs of portal hypertension such as esophageal varices, ascites, and splenomegaly. There are a minority of patients with hepatic APF that present with symptoms of cardiac failure. It is believed that the hepatic sinusoidal resistance seems to protect these patients from cardiac failure, and clinical symptoms are mainly due to the hemodynamic changes in the portal circulation.[3] Young patients with APFs are more prone to develop heart failure due to the presence of low intrahepatic sinusoidal resistance.[4] In most adults, extensive collaterals form throughout the entire bdomen, and the first clinical manifestation of APF is bleeding from gastric or esophageal varices and/or ascites.[1] Although ascites and splenomegaly were present in our patient, symptoms of cardiac failure were the initial clinical manifestations. In this patient, it is likely that the left to right shunting from the arterioportal fistula resulted in increased

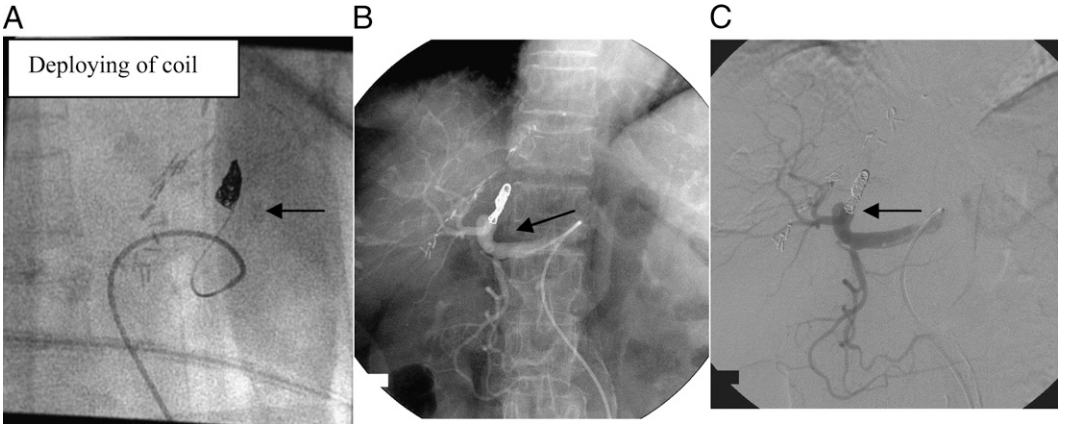

FIG. 2. (*A*): Insertion of nestors platinum microcoils (arrows) via microcatheter. (*B/C*): Unsubtracted and digitally subtraction angiography post embolisation showed successful occlusion of the arterioportal fistula.

venous return and volume loading to the right heart and pulmonary circulation. The subsequent elevation in her pulmonary pressures contributed to her breathlessness.

Decision for further treatment of the patient includes consideration of three important factors. The site and size of the hepatic APF and the clinical state of the patient helps in the decision making process. Our working algorithm states that patients only require treatment if any one of the three factors listed above is positive. Small APF are usually asymptomatic and tend to close spontaneously. Peripherally located APF are also likely to resolve within 3 months whereas central APF are unlikely to resolve spontaneously and thus may require interventions if the patient is symptomatic. This is contrary to certain practices that believe in treatment of asymptomatic fistulas irregardless of the size.

The type of treatment can be divided into angiography with transcatheter embolisation like that performed for our patient or surgical options such as fistula ligation, hepatic resection, and portal caval shunting. Surgery with its relatively higher morbidity is usually reserved for large hepatic APF that fail radiographic intervention. Transcatheter embolisation is currently the mainstay of treatment as it is safe and has a high success rate. As in any procedure involving embolic agents, a major risk of treating large hepatic APF is nontarget embolization of the occluding material. However, risk of hepatic ischemia is low even if there is complete hepatic artery occlusion as over 70 per cent of hepatic circulation and 50 per cent of the liver's oxygen supply are provided by the portal system.

Hepatic APF are uncommon clinical conditions that occur due to a myriad of causes. The clinical presentation is varied and a high index of suspicion is needed to diagnose this disease. Due to the advance of diagnostic techniques, it is increasingly recognized especially after iatrogenic causes. This is a rare presentation of pulmonary hypertension with symptoms of cardiac failure. Treatment depends on three important factors which are: the site, size of hepatic APF, and the clinical state of the patient. Majority of hepatic APF are treated successfully with embolisation of the APF and surgical options with relatively higher morbidity are reserved only for those not amenable to radiographic interventions.

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Cardiac Surgery after Bleomycin Therapy

To the Editor:

Bleomycin is a commonly used antitumor agent effective against lymphomas, nonseminomatous germ cell tumors, and squamous cell cancers of the head and neck. Its major toxicity is interstitial pneumonitis that has been shown to be potentiated by high concentrations of inspired oxygen. More patients with these tumors are surviving and may present for cardiac surgery. Little is known about the morbidity, mortality, and recommended perioperative management of these patients.

We reviewed the records of two patients who underwent cardiac surgery using cardiopulmonary bypass (CPB) and had previously received bleomycin. The first patient was a 58-year-old male with a history of non-Hodgkin's lymphoma and had received bleomycin in combination with other chemotherapeutic agents. He underwent a five vessel coronary artery bypass revascularization procedure. The CPB time was 163 minutes and the cross clamp time was 135 minutes. The second patient was a 55 year-old male with a history of Hodgkin's lymphoma. He underwent a mitral annuloplasty, a three vessel coronary artery bypass, and closure of a patent foramen ovale. The CPB time was 198 minutes and the cross clamp time was 154 minutes. We examined preoperative pulmonary function tests, intraoperative anesthesia and CPB records, and postoperative intensive care unit data.

The average preoperative forced expiratory volume in one second and forced vital capacity were 52 per cent and 55 per cent, respectively. Intraoperatively the patients were maintained on 21 to 26 per cent inspired oxygen while mechanically ventilated. This resulted in an arterial partial pressure of oxygen (paO2) of 51 to 94 mmHg and arterial oxygen saturation of 96 to 100 per cent. While on CPB, the inspired oxygen was deliberately kept below 50 per cent (range 25–50%). This resulted in a paO2 of 85 to 112 mmHg. Both patients were extubated to room air 22 and 23 hours after termination of CPB. Both patients remained on room air for the duration of their hospital stay. Intensive care unit paO2 was 56 to 86 mmHg yielding arterial oxygen saturation of 92 to 100 per cent. Both patients were discharged on postoperative day 6.

Bleomycin is an antitumor agent first isolated from a fungus (*Streptomyces verticillus*) in 1966. It is presently used in the chemotherapeutic regimen of many tumors including Kaposi's sarcoma, cervical cancer, squamous cell carcinomas of the head and neck, germ cell tumors, and lymphomas.

Its mechanism of action centers on the generation of free radicals. More specifically, bleomycin affects the oxidation of Fe^{2+} to Fe^{3+}.[1] This results in the reduction of oxygen which generates free radicals. The free radicals directly damage DNA which leads to cell death.[1] Bleomycin is primarily eliminated by the kidneys.[1] However, a deactivating enzyme—bleomycin hydrolase—is also found in the liver, spleen, bone marrow, and intestine.[2] Therefore, bleomycin toxicity occurs in those organs without the ability to metabolize the drug—the lungs and the skin. The most lethal side effect is pulmonary toxicity. This is a dose-limiting side effect and comes in a few clinical syndromes. The most common form of bleomycin-induced pulmonary toxicity is interstitial pneumonitis and carries a mortality rate of 3 per cent.[3] Because of its renal clearance, kidney failure may increase the effects of bleomycin.[1] Adding radiotherapy to a bleomycin chemotherapy regimen is not associated with a significant increase in pulmonary toxicity.[1]

The onset of bleomycin-induced interstitial pneumonitis may be rapid and accompany treatment induction, or it may occur up to 6 months after discontinuation of the drug.[4] Its clinical presentation is not unique and may mirror pneumonia or pulmonary metastatic disease. Interstitial pneumonitis may cause dyspnea at rest, tachypnea, and cyanosis. There are no pathognomic chest radiographic or histologic findings.[1]

Prevention and treatment of bleomycin-induced pulmonary disease centers around limiting the total dose of bleomycin and using high-dose steroids when symptoms of pulmonary compromise become apparent. The use of prednisone (60–100 mg/day) or equivalent doses of other corticosteroids has been shown in case reports to improve respiratory symptoms.[1] Almost all patients that survive bleomycin-induced interstitial pneumonitis completely recover—including normalization of pulmonary function tests.

We have discussed our successful experience with two patients undergoing cardiopulmonary bypass after having received bleomycin. A coordinated effort among all physician caregivers is necessary to provide optimal care. Limiting the amount of inspired oxygen as much as possible may help prevent bleomycin-associated lung injury and still permits early extubation and hospital discharge. Cardiac surgery can safely

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be performed in the patient that has received bleomycin.

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Subhepatic Abscess Caused by Retained Appendicolith: A Rare Complication Requiring Surgical Intervention

To the Editor:

A 66-year-old female presented with right lower quadrant abdominal pain, nausea, vomiting, fever (100.8° F), and elevated white blood cell count (19,700). On exam she had tenderness at McBurney's point and a palpable mass. CT of the abdomen revealed an enlarged appendix with fecalith and periappendiceal inflammation. The patient underwent laparoscopic appendectomy and was found to have a perforated, necrotic appendix. She was kept on intravenous antibiotics and discharged after 5 days. Two days after discharge the patient presented to the Emergency Room complaining of cough, right flank pain, and shortness of breath. Spiral CT was done to rule out pulmonary embolus. Instead, a new right subdiaphragmatic abscess was revealed posterior to the liver. A central area of density within the abscess was suspicious for a retained appendicolith. The patient was treated with percutaneous drainage of the abscess, and a course of antibiotics. CT confirmed resolution of the fluid collection, and the patient was asymptomatic.

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A follow-up CT scan performed 4 months later showed enlargement of the abscess to 3.5 × 5 cm in size (Figs. 1 and 2). The patient was referred to us for surgical treatment due to the difficult location of the abscess between the right pleural surface and posterior right lobe of the liver and possible need for thoracotomy. A decision was made to attempt a laparoscopic approach first. The patient was taken to the operating room, and access was obtained to the right subcostal area. An abscess cavity, containing purulent fluid and fecalith, was encountered after careful mobilization of the right lobe of the liver. The fecalith was removed and abscess drained. The patient's postoperative course was uneventful and she was discharged home 2 days later. At 6-month follow-up the

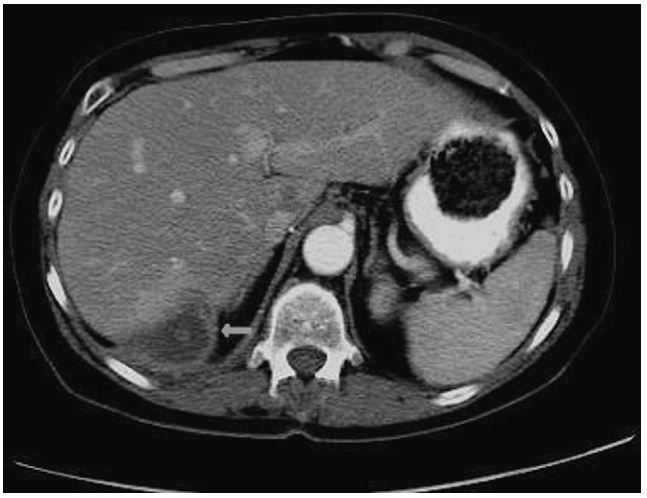

FIG. 1. CT scan of the abdomen *(axial)* demonstrates subhepatic abscess containing the appendicolith *(arrow).*

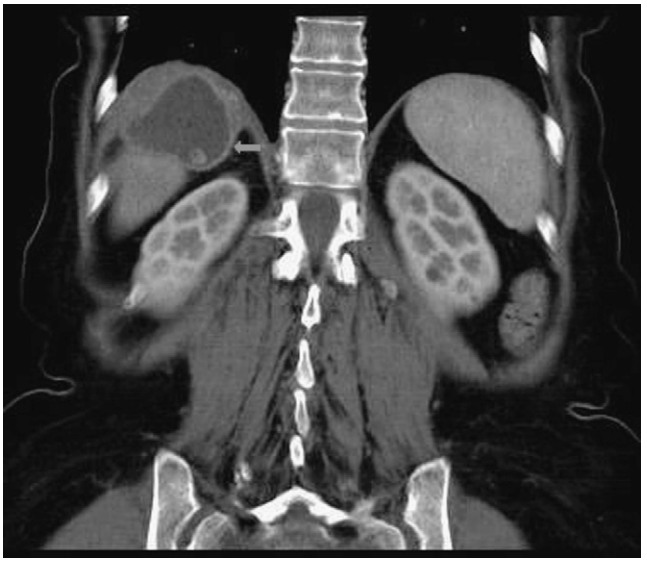

FIG. 2. CT scan of the abdomen *(coronal)* image of subhepatic abscess and appendicolith *(arrow).*

patient remains asymptomatic without evidence of recurrent abscess.

Appendectomy, especially in cases of perforated appendicitis, is associated with postoperative abscess formation in up to 20 per cent of cases. Most can be treated with drainage and antibiotics. However, a minority of these will have a retained appendicolith. Unlike retained gallstones, which are usually sterile and do not cause infectious complications, the appendicolith acts as a nidus for recurrent intra-abdominal abscesses, wound infections, and fistulas. Retained appendicolith has been reported in various locations throughout the abdomen, including the pelvis, gluteal regions, and less frequently Morison's pouch and subhepatic region.[1] It is visualized on CT scan as a fluid collection containing one or more foci of high-attenuation. About 10 per cent of appendicoliths will be visible on plain radiographs.[1]

Percutaneous drainage seems to be successful as an initial treatment measure. However, removal of the appendicolith is necessary to prevent abscess recurrence.[1] Only two other cases of subhepatic abscesses due to retained appendicolith have been reported, and both required surgical removal as a definitive treatment.[2] Laparoscopic drainage proved to be successful in our patient, but an open approach via subcostal incision and even thoracotomy may have been needed.

One case of percutaneous appendicolith removal through an existing fistulous tract has been reported, as well as a more recent case report of a combined fluoroscopic and endoscopic approach.[3] Operative intervention, whether laparoscopic or open appendicolith removal, has been required in other cases. Ultrasound has been described as a useful adjunct for intraoperative localization of the appendicolith.[4]

Appendectomy is associated with a risk for retained appendicolith. High index of suspicion needs to be maintained in patients presenting with recurrent intra-abdominal infections and a history of appendicitis. The risk of retained appendicolith may be reduced by making sure the distal end is intact after division of the appendix. Definitive treatment depends on removal of appendicolith, and can be safely accomplished laparoscopically even in difficult cases.

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Calciphylaxis

To the Editor:

A 68-year-old woman with chronic renal disease, poorly controlled hypertension, and insulin-dependent diabetes mellitus presented to her primary care physician with bilateral pretibial induration and discoloration. The patient was within her third year of dialysis without complication. The pretibial skin was mildly inflamed progressing in the following 3 weeks to focal areas of skin necrosis, discoloration, and inflammation that extended circumferentially below the knee to the ankle.

Physical examination revealed bilateral violaceous pretibial indurated plaques and necrotic ulcerations imposed upon a broad livedo reticularis pattern. The necrotic areas ranged from 2 to 6 centimeters in diameter, and were partially shielded by immature eschars centered within discolored ecchymotic areas. Livedoid purpura were present over the knees (Fig. 1). Pedal pulses were intact bilaterally distal to the lesions. Laboratory studies obtained at admission included: a normal white blood cell count, total serum calcium of 8.7 mg/dL (normal 8.5–10.5 mg/dL), serum phosphate of 4.1 mg/dL (normal 2.5–4.6 mg/dL), and intact parathyroid hormone (PTH) of 1300 pg/mL (normal 10–65 pg/mL).

Radiographs of the legs demonstrated diffuse microcalcification within the soft tissues and subcutaneous vessels (Fig. 2). Doppler ultrasound demonstrated low flow velocities throughout the arterial tree below the popliteal fossa. A full-thickness skin biopsy demonstrated vascular calcification of the subcutaneous arteries and arterioles as well as extravascular calcification of adipose tissue.

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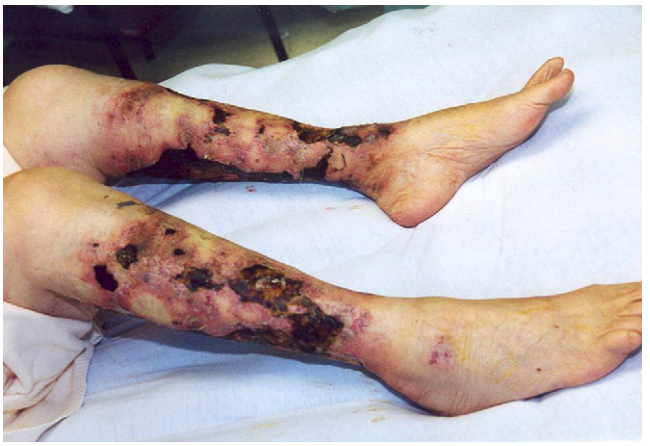

FIG. 1. Skin lesions characterizing calciphylaxis.

Subtotal parathyroidectomy and wide local excision of bilateral lower extremity lesions were performed. Hyperplasia of the glands was demonstrated microscopically.

Two weeks after parathyroid surgery, wide local excision and split-thickness skin grafting were performed. The skin grafts were successful and the patient returned to her previous level of activity.

The neologism "calciphylaxis" was created to describe the disease by compounding calcemia and anaphylaxis.[1] Though many early theories ranging from anaphylactic to hemotogenous pathology have been largely disproven, the title remains prominent. The diversity of proposed pathophysiology reflects the multifactorial nature of calciphylaxis and its treatment.

Among chronic renal failure patients and patients receiving dialysis, prevalence rates of 1 per cent and 4 per cent respectively are commonly referenced.[1] As the dialysis population continues to rise, so too will the likelihood of encountering a patient with calciphylaxis.

Weenig et al.[2] reported a mortality of 81 per cent with a median survival from the date of diagnosis of 2.64 months. Interestingly, proximal disease has been reported to have a worse prognosis with a mortality of 63 per cent whereas distal skin necrosis is reported as 23 per cent.[1] The estimated overall survival rates of dialysis patients with calciphylaxis at 1, 2, and 5 years are 29 per cent, 14.5, and 9.1 per cent respectively.[2] Death is most commonly associated with sepsis resulting from secondary infection of ischemic wounds.

Decreased blood flow and calcium deposition are thought to be important in both initiating and propagating the disease. Mechanisms seen in calciphylaxis that compromise blood flow include intimal fibrosis and calcification, expanding mural calcification of dermohypodermic arterioles, and thrombus formation within spatially related venules.[1, 2] Kidney disease and its accompanying metabolic disturbances remain the most important risk factors of calciphylaxis. Intense focus has been placed on the relationship between hypercalcemia, hyperphosphatemia, and parathyroid hormone levels and their contribution to the pathogenesis of calciphylaxis. Several studies have demonstrated an association between elevated serum calcium and phosphates and the onset and progression of disease leading to the incorporation of these criteria in the National Kidney Foundation Kidney Disease Outcomes Quality Initiative Clinical Practice Guidelines.[3] In contrast, investigators have described calciphylaxis occurring and progressing in patients with normal levels of calcium and phosphates as well as the absence of renal failure.[1, 2, 4] Several independent risk factors have been identified in patients with normal calcium and phosphate including obesity, female gender, and corticosteroid use, although none has a significant predictive value.[2]

Calciphylaxis commonly presents after local trauma with a high incidence of anterior tibial involvement.

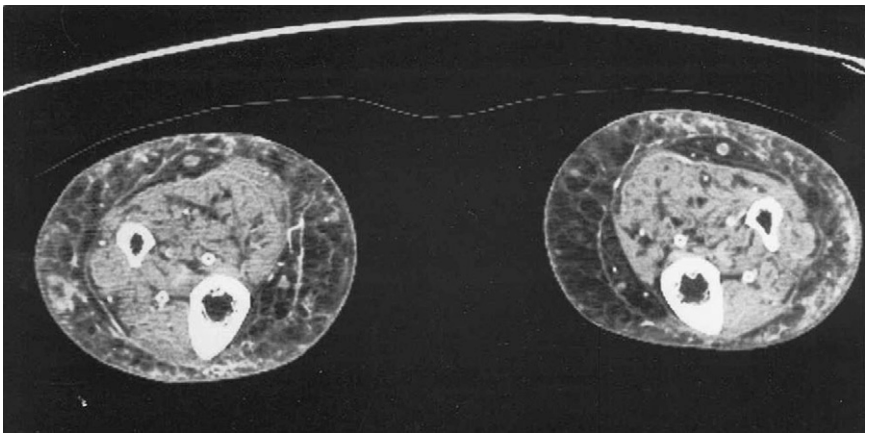

FIG. 2. Computed tomography of the lower extremities demonstrating with soft tissue calcification.

Ischemic changes within the dermis and subcutaneous fat ensue resulting in livedo reticularis, and/or violaceous, painful, plaque-like subcutaneous nodules, which progress to ischemic/necrotic ulcerations. The linear progression from ischemic change to ulceration is irreversible and interruption of the disease process has not been universally successful with any treatment.[1]

Advances in the medical management of calciphylaxis continue to emerge. Extensive research has been done in the areas of pharmacologic and physiologic interventions although none has been universally successful. Surgical management of the nonhealing necrotic skin lesions has been successful in retrospective studies and case reports, and has improved overall morbidity and survival of the disease.[2–4] Local debridement and excisional biopsy followed by wide local excision provide both a histopathologic diagnosis and definitive treatment. Aggressive wound care with or without parathyroidectomy has consistently improved patient outcomes when medical management has failed.[1, 4]

The role of PTH and therefore parathyroidectomy remains controversial. The definitive role of PTH in the pathogenesis of calciphylaxis remains elusive. Despite the ongoing search for the treatment mechanism, parathyroidectomy is known to be associated with a rapid resolution of cutaneous wounds and pain as well as a longer median survival in patients with calciphylaxis.[4] In a prospective study spanning 15 years and 65 patients, Duffy et al.[4] concluded that subtotal and total parathyroidectomy improve long term survival and short term wound healing if performed early in the course of the disease. The National Kidney Foundation Kidney Disease Outcomes Quality Initiative Clinical Practice Guidelines recommend parathyroidectomy in patients with PTH > 800 pg/mL and plasma calcium and phosphorous concentrations refractory to medical management.[3]

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Tubular Carcinoid Tumor: A Rare Cause of Appendicitis

To the Editor:

Tubular carcinoid tumors are extremely rare occurrences with a paucity of information regarding their optimal management. Here we report a case of an appendiceal tubular carcinoid tumor and investigate diagnostic and therapeutic options based on current literature. A healthy 31-year-old male presented to the Emergency Room complaining of right lower quadrant (RLQ) abdominal pain and nausea. He denied chest pain, shortness of breath, fever, chills, or change in bowel function. On physical exam, he was afebrile with moderate RLQ tenderness to palpation. Laboratory results revealed a leukocytosis of 16.6. He was clinically diagnosed with acute appendicitis, started on intravenous antibiotics, and taken to the operating room for laparoscopic appendectomy. His postoperative course was unremarkable and he was discharged home on postoperative day 1 tolerating a regular diet.

On pathologic exam, a 0.3 cm well circumscribed mass was appreciated in the tip of the appendix. Immunohistochemical stains were positive for glucagon (Fig. 1), neuron-specific enolase, synaptophysin, AE1/AE3, and negative for chromogranin A; all consistent with a diagnosis of tubular carcinoid tumor. As the tumor was less than 1 cm without lymphatic involvement, appendectomy was deemed curative and no further operative intervention was warranted.

Tubular carcinoids are poorly circumscribed tumors that are diffusely infiltrative and characterized by small tubular structures and short lines of cells within an abundant stroma.[1] They are most commonly found in the appendix and diagnosis is made by histopathologic examination.[2] Tubular carcinoids exhibit predominantly glandular L-cell differentiation. They are argyrophil but nonargentaffin and have variable immunoexpression. Tubular carcinoids classically express glucagon and chromogranin B. Diagnostic confusion may occur because tubular carcinoids rarely stain positive for chromogranin A, a hallmark of typical carcinoid tumor identification. In addition, unlike other carcinoid tumors, they typically stain negative for serotonin.[1]

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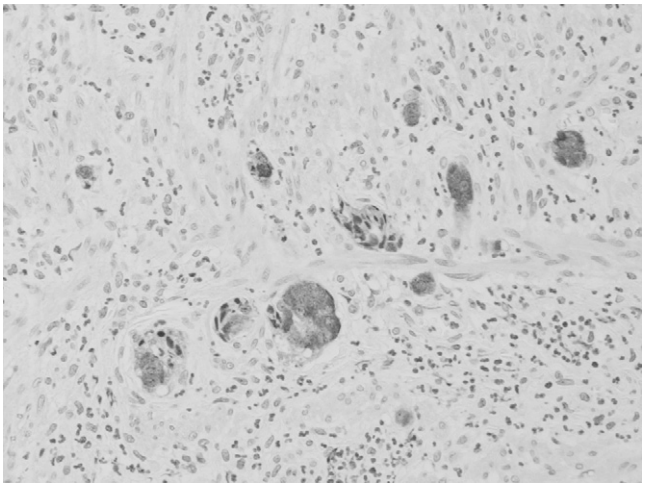

FIG. 1. Tubular carcinoids are typically positive for glucagon, which helps to differentiate it from other variants of carcinoid tumors. (Glucagon stain)

The cord like glandular architecture of these tumors may bear resemblance to both goblet cell carcinoids and well-differentiated adenocarcinomas with a desmoplastic stromal reaction.[3] Rare cases have been reported where lesions will possess both tubular and goblet cell features.[2] A crucial difference between tubular and goblet cell carcinoids is the lack of mucin.[1, 3] Mucin is rarely identified within the lumen or cell cytoplasm of tubular carcinoids.[2] Features that distinguish tubular carcinoids from adenocarcinoma is their orderly cell pattern, lack of cytological atypia, and absence of mitotic activity.[2]

Although often asymptomatic, tubular carcinoid tumors may present similarly to acute appendicitis. Tubular carcinoids, unlike other atypical carcinoid tumors such as goblet cell carcinoids, do not exhibit an increased risk of metastasis and appendectomy for lesions less than 2 cm is curative.[4] Right hemicolectomy should be reserved for tumors greater than 2 cm, cases of incomplete excision, or regional nodal metastasis.[4] Based on current literature, we recommend tubular carcinoids be approached in the same manner as typical carcinoid tumors; except in cases where tumors exhibit both tubular and goblet cell features. These tumors should be treated as goblet cell carcinoids.[2]

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Mucoepidermoid Carcinoma of the Thyroid and the Parotid Glands

To the Editor:

Mucoepidermoid carcinoma is a tumor that primarily affects the salivary glands. It was first described by Volkmann in 1895[1] and named as "mucoepidermoid carcinoma" by Stewart et al.[2] Although it is typically the malignancy of salivary glands, it has been reported in other tissues like bronchus, lung, larynx, esophagus, breast, pancreas, oral cavity, and thyroid as well. Mucoepidermoid carcinoma of the thyroid is rare and there are only small series or case reports about the pathology.

Two different types of mucoepidermoid carcinomas are seen in the thyroid gland. These are the mucoepidermoid carcinoma and the sclerosing mucoepidermoid carcinoma with eosinophilia.

The histogenesis of the mucoepidermoid carcinoma of the thyroid gland is controversial. The tumor may develop from solid cell nests, follicular cells, C cells, parathyroid, ectopic salivary gland, or thyroglossal duct. Mucoepidermoid carcinoma of the thyroid gland may also be considered as a differentiated form of papillary thyroid carcinoma.[3]

The mucoepidermoid carcinoma of the parotid gland is more common than the mucoepidermoid carcinoma of the thyroid gland. The mucoepidermoid carcinoma of the parotid gland can present as a second malignant neoplasm[4] or it may be a part of multiple primary tumors.

We report a case in which a patient was diagnosed with parotid mucoepidermoid carcinoma 4 years after the diagnosis of thyroid mucoepidermoid carcinoma. A 23-year-old woman presented with a neck mass in January 2000. There was a mobile but firm thyroid nodule of 2.5 cm on the right thyroid lobe on physical examination. The patient was euthyroid. The thyroglobulin level was 50 ng/mL (normal). Thyroid ultrasonography revealed a 2.5 cm hypoechoic nodule with an anechoic peripheral halo in the inferior pole of the right thyroid lobe. There

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were hyperchromatic nuclei, nuclear pleomorphism, and hurtle cell like follicular cells on fine needle aspiration cytology. The nodule seemed to be hypoactive on thyroid scintigraphy. The patient underwent surgery and when the frozen section of a central lymph node on the right side revealed papillary thyroid carcinoma, total thyroidectomy with right sided modified radical neck dissection was performed.

The pathology of the specimen was first reported to be poorly differentiated papillary thyroid carcinoma. The tumor was 2.1 cm in greatest diameter. It was very near to the thyroid capsule (1–2 mm) but there was no capsule invasion. The left lobe of the thyroid gland showed lymphocytic thyroiditis and out of the 18 dissected lymph nodes, two were metastatic. She received radioactive iodine therapy after the surgery and she was also given levothyroxine at a dose of 250 mg/day. When the specimen was reevaluated, it was diagnosed to be mucoepidermoid carcinoma of the thyroid gland. During her follow-up, when she was pregnant for 17 weeks to her first baby, she was found to have a 2 cm solid mass in the anteroinferior aspect of the right parotid gland in March 2004. The fine needle aspiration cytology of this mass was reported to be highly suspicious of being low grade mucoepidermoid carcinoma and right superficial parotidectomy was performed. On pathological examination there was a 1 cm low grade mucoepidermoid carcinoma and some of the surgical margins were positive with tumor. She did not receive any adjuvant therapy after the surgery and she gave birth to a term, healthy baby. She is now doing well without any signs of recurrences or metastasis.

Mucoepidermoid carcinomas of the thyroid and parotid glands are rare malignancies so there are many controversies about the pathology in the literature. To our knowledge this is the first case in the literature that mucoepidermoid carcinoma affected both the thyroid and the parotid glands and this gives rise to new questions. We do not know the relationship of the two pathologies. A same genetic or environmental factor might be effective, parotid gland carcinoma can be a result of the therapeutic efforts of thyroid carcinoma, or one may be the metastases of the other. Until more cases are reported to answer these questions, close follow-up of patients with the diagnosis of the mucoepidermoid carcinoma may be wise.

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Lymphoepithelial Cysts of the Pancreas: A Sheep in Wolves Clothing

To the Editor:

Lymphoepithelial cysts of the pancreas (LECs) are rare nonneoplastic lesions lined by keratinizing squamous epithelium and surrounded by lymphoid tissue. These lesions may mimic other cystic lesions such as dermoid cysts, epidermoid cysts, pancreatic cystadenoma, cystadenocarcinoma, and pseudocysts. Histogenesis of this lesion is not implicit, and differentiation from other cystic lesions of the pancreas is necessary. A review of literature encompassing clinical presentation, diagnosis, and management is presented. To date, only 66 cases have been reported in the English literature. We report an additional case of an asymptomatic lymphoepithelial cyst in the head of the pancreas and discuss relevant literature and treatment.

A 59-year-old male was incidentally found to have a cystic neoplasm in the head of the pancreas in the course of a workup for unrelated problems. The patient reported no abdominal pain, fever, jaundice, or pancreatic insufficiency. Physical exam was unremarkable. The patient was not a heavy alcohol drinker and denied a history of pancreatitis. Significant surgical history included a prior cholecystectomy. Pertinent laboratory evaluation revealed a carbohydrate antigen (CA)19–9 level of 38 ng/mL and a carcinoembryonic antigen (CEA) level of 4.5 ng/mL. All other lab values were within normal limits. Endoscopic ultrasound with fine needle aspiration revealed a nonserous, thick yellow fluid with rare cellular atypia. No malignant cells were seen. Computed tomography revealed a 5.0 $\times$ 5.2 cm multiloculated cystic mass in the head of the pancreas extending into the uncinate process (Fig. 1). The patient underwent a conventional Whipple procedure and discharged home on a regular diet on postoperative day 6.

On macroscopic examination, the deep peripheral posterior aspect of the pancreatic head revealed a

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multiloculated cystic lesion measuring $4.2 \times 3.1 \times 1.7$ cm and located 1.3 cm from the distal pancreatic margin (Fig. 2). No solid mass was identified. On sectioning the pancreatic head, the cystic lesion was found to be located at the periphery of the pancreas (Fig. 2). The cysts were lined by keratinizing squamous mucosa with luminal keratin debris and surrounded by a dense lymphocytic infiltrate with occasional germinal center formation; the adjacent pancreatic tissue was histologically unremarkable. A diagnosis of multiloculated lymphoepithelial cyst of the pancreas was made (Fig. 2).

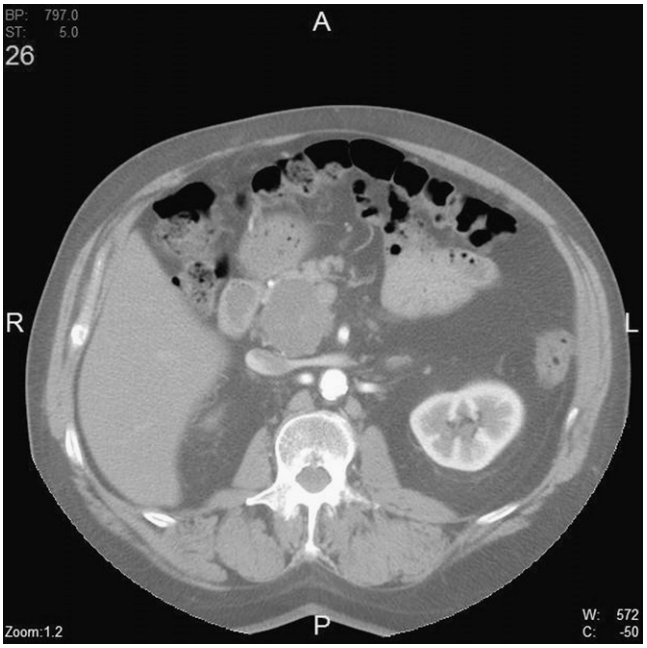

FIG. 1. Computed tomography (CT) of the abdomen demonstrating a complex cyst within the pancreatic head and uncinate process *(white arrow).*

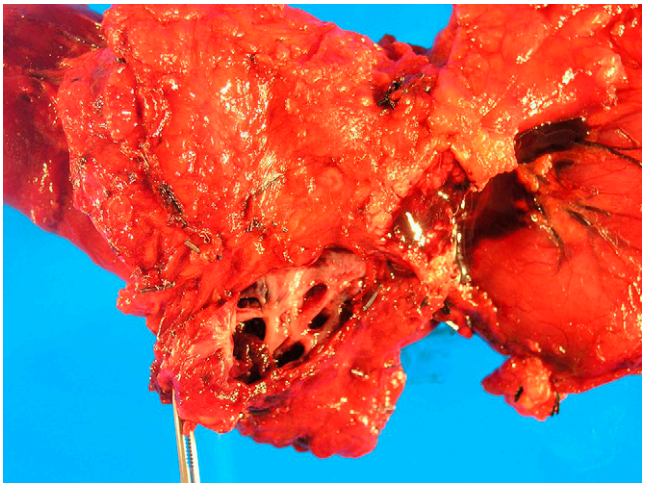

FIG. 2. Gross specimen revealing multilocular peripheral pancreatic cysts and adjacent unremarkable pancreatic tissue *(white arrow).*

A histopathologic diagnosis of lymphoepithelial cyst of the pancreas was first proposed by Truong et al. in 1987 and included three separate hypotheses: 1) Squamous metaplasia of an obstructed and enlarged intrapancreatic duct that consequently projected into a peripancreatic lymph node; 2) Misplaced portion of the branchial cleft that became fused with the pancreatic enlage during embryogenesis (presently no evidence to prove this theory); or 3) Benign epithelial inclusion in a peripancreatic lymph node resulting in subsequent squamous metaplasia from chronic irritation and accumulation of keratinized material.[1, 2] Truong et al. found no evidence of extrapancreatic tissue in their examination of 435 peripancreatic lymph nodes. Although a correlation between the Epstein-Barr virus (EBV), lymphoepithelial carcinoma of the pancreas, and lymphoepithelial cysts of the parotid gland has been made, lymphoepithelial cysts found in the pancreas showed no relationship to EBV.[3]

Lymphoepithelial pancreatic cysts are most common in asymptomatic middle-aged men and are usually incidental findings. Occasionally patients may present with vague abdominal pain, diarrhea, nausea, and vomiting accompanied by general malaise. Physical exam is often unremarkable. Computed tomography findings are nonspecific and may demonstrate unilocular or multilocular cystic lesions with low Hounsfield units to findings of an isodense mass.[4] One explanation for describing LECs as solid or semisolid is the fact that they are filled with debris and keratinous material.[4] Computed tomography that demonstrates a well-marginated, low-attenuation mass accompanied by a thin enhancing rim in close proximity to the pancreas and sharply demarcated from the anterior surface of the pancreatic body or tail may be indicative of a lymphoepithelial cyst.[2] Nevertheless, lymphoepithelial cysts may still be hard to discriminate from pseudocysts on computed tomography. Fat-suppressed T1 weighted MRI may be more helpful because the keratin component of lymphoepithelial cysts would show a high signal in T1 with a low signal in T2.[4] That said, there are presently no radiologic characteristics that permit precise distinction between a lymphoepithelial cyst and other neoplasms of the pancreas.[3] Endoscopic retrograde cholangiopancreatography may be normal but could reveal focal compression of the duct of Wirsung or obstruction of the common bile duct if the lesion arises from the head of the pancreas.[2]

Preoperative diagnoses are further clouded by laboratory values. Presently there seems to be no correlation between LECs and CA 19–9. Cyst fluid analyses for CA 19–9, CA 125, amylase, and CEA have been assessed and report conflicting results.[3] Fine needle aspiration of the lesion is important for diagnosis because it can allude to the benign nature and also

identify it as a true cyst.[3] Although cytopathologic examination may reveal features shared by many cystic lesions of the pancreas, the presence of squamous epithelial cells along with rare lymphocytes devoid of any neoplastic cells is usually diagnostic, and permits differentiation from a dermoid or an epidermoid cyst occurring in an intrapancreatic accessory spleen.[3] Therefore, preoperative fine needle aspiration (FNA) can change management if the benign nature of LEC is made.

Despite the fact that LECs are difficult to distinguish from other cystic lesions of the pancreas there are certain factors that are helpful. LECs have a macrocystic appearance that separates them from microcystic lesions such as serous microcystic adenoma.[5] The lymphoid reaction, specifically subepithelial banding, discriminate LECs from mucinous cystic neoplasms, intraductal papillary mucinous tumors, and intraductal oncocytic papillary mucinous neoplasms, where as an acute inflammatory component or granulation tissue would lean towards the diagnoses of pseudocyst.[5] However one should note, pseudocysts lack the characteristic lymphoid tissue and squamous lining of a lymphoepithelial cyst and are closely associated with prior history of pancreatitis.[5]

True pancreatic cysts, which are distinguished by their epithelial lining, are the rarest form of cystic pancreatic lesions. The lymphoepithelial cyst of the pancreas is an extremely rare benign neoplasm of unknown etiology. This uncommon lesion should be considered in the differential diagnosis of cystic neoplasms of the pancreas. Presently, preoperative histological identification is usually not possible and operative intervention is undertaken in most cases to differentiate from mucinous cystadenoma and cystadenocarcinoma.

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Surviving Right Atrial Rupture

To the Editor:

A 17-year-old man presented to our institution after being involved in a motor vehicle crash. He was a restrained driver with airbag deployment. At the scene, he was noted to be short of breath and diaphoretic. Upon arrival to the Emergency Room, his initial vital signs were as follows: a respiratory rate of 26, pulse of 84, and blood pressure of 93/41. Hemoglobin and Hematocrit were 11.6 and 33.8, respectively. The patient was dyspneic and reported chest, upper abdominal, and left lower extremity pain. His initial exam was significant for labored breathing, muffled heart tones, and cyanosis of both upper extremities, head and neck. A Focused Assessment with Sonography for Trauma (FAST) exam was performed by the trauma team, which demonstrated fluid within the pericardial space. The patient was taken emergently to the operating room.

A pericardial window was performed, which confirmed the presence of blood in the pericardial space and was followed by a midline sternotomy. A pericardotomy was performed that yielded a significant amount of blood. A 2 cm laceration was identified in the right atrial appendage and the bleeding was initially controlled with Satinsky and C-clamps. The defect was closed using three horizontal mattress sutures with 4–0 pledgeted Prolene. The sternotomy was closed in layers. Except for a short episode of hypotension during the pericardiotomy, the patient remained stable through out the procedure. He received six units of packed red blood cells during the course of the operation. He was taken postoperatively to the CT scanner for completion of his trauma workup. His postoperative course was uneventful. An echocardiogram was performed on postoperative day 3 that showed global cardiac dyskinesis and a normal

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ejection fraction. He was discharged home on postoperative day 7 in good condition.

Blunt Cardiac injury (BCI) is defined as cardiac damage resulting from nonpenetrating chest trauma. It can be fatal at the trauma scene, and is frequently missed in the trauma bay.[2] BCI can vary based on both the mechanism as well as the degree of force. Injuries include cardiac contusion, rupture of cardiac chamber, valves, or valvular apparatus, or coronary arterial damage. According to a recent study from the Centers for Disease Control, the occurrence of right atrial rupture after a motor vehicle accident is uncommon.[3] A study of nearly 10,000 trauma patients admitted to the Shock Trauma Center of the Maryland Institute for Emergency Medical Systems with blunt trauma showed an incidence of 0.14 per cent for right atrial rupture.[1] Recent studies show that prompt diagnosis and treatment can improve chances of survival by nearly 80 per cent for patients suffering this type of devastating injury.[4] Blunt cardiac injury may have many different presentations and because there are no universally accepted diagnostic criteria, the true incidence remains unknown. Consequences range from clinically insignificant to nearly instantaneous mortal injury. Emergency room physicians and trauma surgeons must have a high degree of suspicion because early diagnosis and intervention are vital to patient survival . The diagnosis of BCI remains difficult to make due to associated injuries that divert physicians' attention, the lack of specific physical findings, and the lack of specificity of noninvasive tests available in an emergency room. In our case with right atrial rupture, the employment of FAST led to immediate diagnosis of pericardial tamponade and subsequent operative intervention. In conclusion, the use of this modality early in the evaluation of all trauma patients presenting with the appropriate mechanism of injury is recommended.

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Primary Hepatoid Adenocarcinoma of Retroperitoneum

To the Editor:

Hepatoid adenocarcinoma (HAC) is a type of adenocarcinoma that has morphologic similarity to hepatocellular carcinoma (HCC). We report an unusual case of primary retroperitoneal tumor presented with clinical and radiological features suggestive of sarcoma, which later diagnosed as a hepatoid adenocarcinoma on histopathology. A 47-year-old African American male presented to the hospital with a 3-month history of swelling and pain noticed in the left upper thigh. The pain that was located in the thigh was nonradiating, constant, and slowly increasing in intensity. The patient noticed progressively increasing swelling of both legs. He also noticed significant loss of weight and appetite from the previous 6 months. No significant past medical or surgical history was noted. On examination, the patient was found to have bilateral edema extending up to the knees. No lymph nodal enlargement was noted. Abdominal examination was benign without evidence of any organomegaly or inguinal hernia. Examination of scrotum failed to reveal any evidence of masses. Spinal tenderness was noted at multiple lumbar vertebral levels. Other systemic examination was within the normal limits. Stool guaic was negative.

On investigation, tumor markers showed elevated α–fetoprotein (3102 ng/mL) with normal Beta human chorionic gonadotrophin (HCG) (0.2 mIu/mL). Twenty-four hour urine immunoelectrophoresis showed: polyclonal Immunoglobulin G (IGG) (3056 mg/dL); 24-hour urine (K 81mg/mL); and protein 1.01. X- ray of chest revealed normal cardiac shadow without any space occupying lesions. CT scan abdomen showed a 10×8 cm retroperitoneal mass on left side encroaching upon psoas muscle from anterior destroying L3 vertebral body (Fig. 1). Sarcoma of psoas muscle is leading differential. No focal lesions were noted in the liver. No evidence of ascites or pleural effusion was noted. CT of chest and head were within normal limits without any evidence of metastatic disease. A bone scan showed increased uptake in lumbar vertebrae. Testicular sonogram ruled out any testicular mass. A CT guided biopsy of the left retroperitoneal

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mass was obtained. Pathology showed morphological (microscopic features show tumor cells with eosinophilic cytoplasm proliferate in trabecular pattern) and immunophenotypical features consistent with adenocarcinoma with hepatoid differentiation (Pancytokeratin, S-100, Vimentin, CAM5.2 and Inhibin, all negative; HepPar1 and OCH1E5 both positive). Positron emission tomography (PET) scan also showed large, hypermetabolic retroperitoneal neoplasm extending throughout the course of the left psoas muscle with concomitant erosion of the left lateral aspect of L3 vertebral body. A hypermetabolic focus is also noted in the sigmoid colon. Normal distribution of fluorodeoxyglucose was noted in the liver, spleen, kidneys, and suprarenal regions. Colonoscopy failed to reveal any growth in the colon. Exploration and debulking surgery had been offered initially, however, the patient refused any surgical intervention. Palliative radiotherapy was given for extensive bony involvement. Repeat CT scan performed after 3 months showed increase in tumor size with compression of inferior vena cava. No mass was noted in the liver. A repeat CT guided biopsy that was performed at this time also revealed similar features. The patient is presently receiving chemotherapy with Nexavar (sorafenib, a tyrosine kinase inhibitor) (Bayer HealthCare Pharmaceuticals, Wayne, NJ).

Hepatoid adenocarcinomas are reported to arise from several extrahepatic tissues in the literature. In 1985 Ishikura et al.[1] defined hepatoid adenocarcinoma as tumors that have histological characteristics of liver and also produce alpha fetoprotein. These tumors resemble hepatocellular carcinoma in terms of their expansive tumor growth that is basically composed of large eosinophilic or clear cells, sometimes with granular cytoplasm, growing in a sheet like or trabecular pattern with sinusoidal vascular channels.[2] The presence of alpha fetoprotein may be an important diagnostic aid. However it may not be elevated universally.[3, 4] In our case report elevated alpha fetoprotein prompted us for further investigation.

Alpha fetoprotein can be elevated in tumors that arise from teratomatous germ cell origin, hepatocellular carcinoma, and hepatoid adenocarcinomas. Retroperitoneum can be a metastatic site for germ cells and occasionally liver tumors. However, the possibility of germ cell tumors is highly unlikely in our case because of absence of germ cell elements in the histopathology. Another rare possibility, primary hepatic cancer metastasizing to retroperitoneum, was also entertained. Absence of any space occupying lesion on CT scan and lack of hypermetabolic foci on PET scan made this possibility highly unlikely. Several reports in the literature postulated that hepatoid adenocarcinoma can arise from abnormal totipotent cell rests in the tissues (lung and peritoneum). It is quite possible that the tumor might have been developed from these totipotent cell rests in the retroperitoneum.

The prognosis of these hepatoid tumors reported in the literature is generally poor. In general these tumors are either locally advanced or metastatic at the time of diagnosis. Distant metastasis is a common feature with these tumors. Hepatoid adenocarcinomas from stomach, colon, and pancreas have been reported to metastasize to lymph node and liver by the time of diagnosis.[5, 6] Interestingly, our case tumor is locally invasive. It is difficult determine the survival as most of the studies in the literature reported are case series only.

In summary, hepatoid adenocarcinomas are a heterogenous group of tumors that have histological features similar to hepatocellular adenocarcinoma. This should be considered in differential diagnosis of retroperitoneal tumors with elevated levels of alpha fetoprotein in males. In general the prognosis of these tumors is poor.

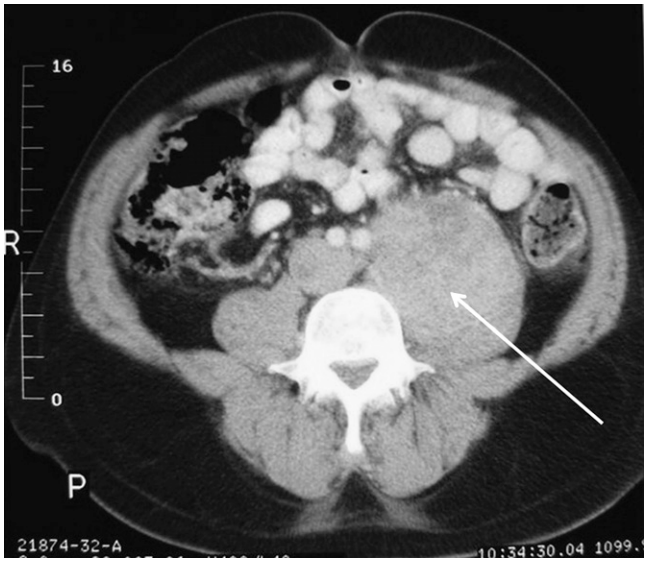

FIG. 1. CT scan showing large retroperitoneal tumor encroaching onto the left psoas muscle.

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Rupture of a Giant Renal Artery Aneurysm

To the Editor:

Renal artery aneurysms (RAA) are encountered infrequently due to their rarity and lack of clinical symptoms. Management of RAA is presently evolving with broader indications for treatment and advances in endovascular approaches. We describe an unusual case of a ruptured giant RAA.

A 54-year-old male presented with acute right flank pain and syncope. His past medical history was significant for refractory hypertension and chronic anticoagulation due to previous mitral valve replacement. Physical examination revealed pallor, sinus tachycardia, and severe right flank tenderness. Significant laboratory values included hematocrit 25.6 per cent (normal, 38–51%), international normalized ratio 4.3 (prosthetic valve therapeutic range 2.5–3.5), and creatinine 2.5 mg/dL (normal, 0.7–1.5 mg/dL).

Fluid resuscitation was initiated along with correction of coagulation indices. A noncontrasted CT scan of the abdomen revealed a 12.5 cm right RAA associated with retroperitoneal bleeding and a large perinephric hematoma (Fig. 1). Selective renal angiography with microcoil embolization of the main renal artery was performed (Fig. 2). Ongoing hemorrhage was clinically evident however and the patient subsequently required nephrectomy. His postoperative course was unremarkable and follow-up examinations demonstrate satisfactory blood pressure control and normal renal function.

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RAA occur in approximately 0.1 per cent of the population and are more common in females. They are typically saccular in nature and tend to occur at arterial branch points, most frequently affecting the right main renal artery bifurcation. They occasionally are multiple and rarely occur bilaterally. There is an infrequent association with extrarenal aneurysms. Fibromuscular dysplasia accounts for the majority of cases whereas atherosclerosis may not play as

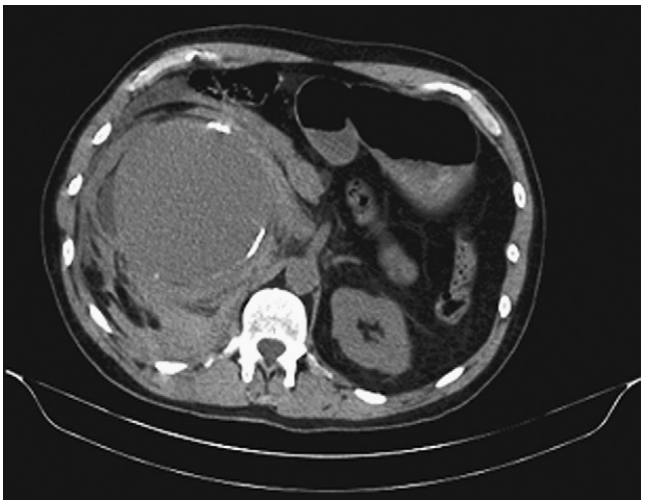

FIG. 1. Noncontrasted axial computed tomography scan demonstrating a giant right renal artery aneurysm with intramural calcifications and surrounding hematoma suggestive of acute rupture.

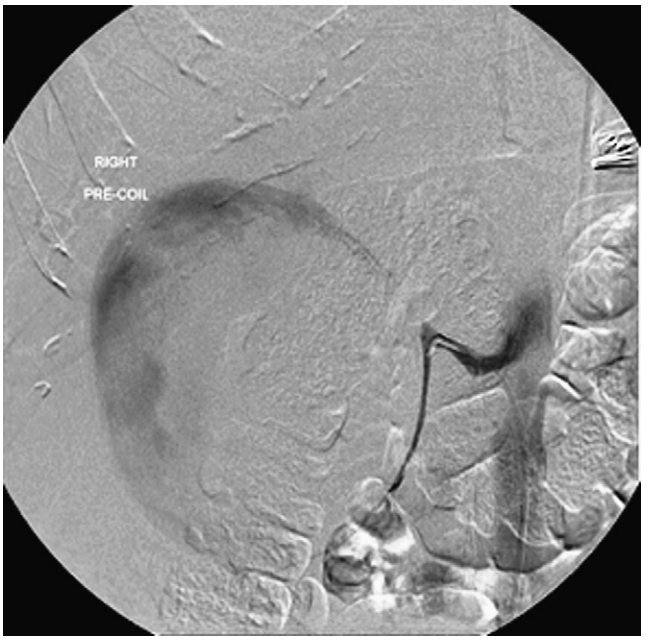

FIG. 2. Selective right renal arteriogram showing a giant renal artery aneurysm just distal to the origin containing luminal thrombus.

significant a role as it does in other systemic aneurysms. Likewise, characteristics of patients with RAA tend to differ from patients with other visceral or peripheral aneurysms. For instance, coexistent coronary or peripheral vascular disease was present in only 25 to 35 per cent of patients considered for RAA repair in two recent surgical series.[1–2] In one of these studies, less than 20 per cent of patients were former or current tobacco users.[1] Low rates of coexisting diabetes have been found as well.

A significant proportion of RAA is diagnosed during renal arteriography for suspected renovascular hypertension. Hypertension is a strikingly common comorbidity found in patients undergoing repair of RAA, with 89 per cent of such patients presenting with this finding in one review.[2] Suggested mechanisms for this relationship include mechanical or rheological effects of the aneurysm itself, concomitant renal artery stenosis, and embolization of the renal parenchyma. Renin-mediated hypertension can be difficult to control with medication alone and often multiple medications are required.

Aneurysm rupture is a potentially fatal complication of RAA that forms much of the rationale for repair. However, the risk of rupture for typical RAA is likely overestimated. English et al.[2] found no incidence of rupture in unrepaired RAA smaller than 2.0 cm over a mean follow-up period of nearly 3 years in their review. Selective nonoperative management of RAA averaging 1.3 cm also showed no incidence of rupture over a mean follow-up period of 6 years in a similar study.[1] Clearly, the risk of rupture increases with increasing aneurysm size, particularly when large caliber aneurysms are considered. Nonetheless, for characteristic RAA, *i.e.,* those ranging from > 1.0 to 2.5 cm, more than just absolute size should be considered when contemplating management. Commonly cited risk factors for rupture other than size consist of gender, childbearing status, aneurysm morphology, and histologic characteristics. A disproportionate percentage of ruptures have been found to occur during pregnancy thus childbearing potential represents an absolute indication for repair. Historically, fusiform morphology and the presence of calcifications were felt to be protective against rupture however this has been refuted in more recent literature.[1]

Presently recognized indications for repair include all symptomatic aneurysms, asymptomatic aneurysms 2.0 cm or greater in males and postmenopausal females, and all aneurysms in women of childbearing age. In their comprehensive review, Henke et al.[1] suggest repair of RAA ≥ 1.0 cm in patients with recalcitrant hypertension, all RAA ≥ 2.0 cm, and most RAA between 1.5 and 2.0 cm. Significant reductions in blood pressure as well as the number of antihypertensive medications required after RAA repair form the basis of these expanded indications. A European study using similar rationale for surgery achieved good long-term results as well.[3] Given that consequences of longstanding hypertension are generally irreversible, it is prudent to consider repair in patients with refractory hypertension rather than on the basis of absolute size alone.

Options for repair include surgical and endovascular approaches. Surgical repair has been shown to produce excellent outcomes with longstanding durability and minimal complications. Endovascular treatment is rapidly evolving and presently offers a variety of treatment options via a percutaneous approach. Nephrectomy, formerly common in complex RAA, is now required only in rare instances. Even in the setting of aneurysm rupture, renal salvage via open or endovascular techniques is commonly achievable but unfortunately was not possible in the patient presented here.

In experienced hands, the safety and durability of surgical repair of RAA is well documented. Three large series have been published in recent years documenting low morbidity and mortality rates after surgical repair.[1–3] Significant morbidity ranged from 4 to 17 per cent whereas mortality was less than 2 per cent. Primary patency rates were 93 to 96 per cent with follow-up periods ranging from 46 to 91 months. Furthermore, significant improvements in blood pressure were noted in roughly half the patients in each study and have supported broader indications for surgical repair.

Endovascular options include simple coil embolization, exclusion of the aneurysm with a covered vascular stent, or a combination of these techniques. Angiographic occlusion of the parent artery or even the main renal artery is another viable option and can be performed expeditiously in critical situations. Encouraging results have been obtained with endovascular methods with several studies demonstrating safety and effectiveness as well as reductions in blood pressure.[4] The lack of long-term follow-up and the relative small number of patients included in these studies precludes firm conclusions regarding durability and prevention of rupture after endovascular repair.

The case presented here represents both an unusual presentation and outcome of a large aneurysm of the renal artery. The overwhelming majority of RAA can be repaired safely, durably, and without kidney loss

today. The additional benefit of significant improvement in hypertension is experienced by many patients after aneurysm repair and this should be factored into surgical decision-making.

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