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Abdominal Imaging

Four-year study of abdominal ultrasound in 900 Central African adults with AIDS referred for diagnostic imaging

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Abstract

Background: In the majority of sub-Saharan African countries, the absence of computed tomography facilities makes abdominal ultrasound (US) an alternative diagnostic tool in the clinical investigation of infectious and noninfectious complications of human immunodeficiency virus (HIV)–infected individuals. We studied the abdominal US findings in Central African adult AIDS patients to determine whether the findings were consistent between different population groups and neighboring countries. We performed a longitudinal study of AIDS patients and age- and sex-matched HIV-negative adults referred for abdominal US at two tertiary referral city hospitals: the Gecamines Sendwe Hospital (GSH), Lubumbashi, Congo, and the University Teaching Hospital (UTH), Lusaka, Zambia.

Methods: Between 1992 and 1996, abdominal US findings in 900 adults (300 Congolese adults from GSH and 600 Zambian adults from UTH; age range = 15–55 years) with a diagnosis of AIDS referred for diagnostic imaging from the inpatient medical wards were recorded; 900 abdominal ultrasound findings from age and sex-matched HIV-negative adults were studied for comparative purposes.

Results: Abdominal US for diagnostic purposes in AIDS patients is requested by clinicians for a range of primary clinical indications: abdominal pain, fever of unknown origin, hepatosplenomegaly, lymphadenopathy, and abnormal liver function tests. Compared with the HIV− individuals, the AIDS group of patients had a significantly higher proportion of splenomegaly (35% vs. 24%; $p \leq 0.001$), hepatomegaly (35% vs. 22%; $p = 0.001$), lymphadenopathy (31% vs. 11%; $p \leq 0.001$), biliary tract abnormalities (25% vs. 12%; $p \leq 0.001$), gut wall thickening (15% vs. 5%; $p \leq 0.001$), and ascites (22% vs. 9%; $p \leq 0.001$). There were no differences in renal tract and pancreatic abnormalities between the AIDS and HIV− groups. There were significantly fewer gallstones in the AIDS group (23% vs. 75%; $p \leq 0.001$). These patterns of abdominal US abnormalities were consistent across both hospitals.

Conclusions: Diagnostic imaging by abdominal US is commonly used in the management of a variety of clinical indications in Central Africa. The changes seen on abdominal US in AIDS patients appear uniform across the two countries in Central Africa. These findings may have implications for the radiologist, especially in developing countries, where accurate microbiological or pathologic diagnosis of infectious and noninfectious diseases afflicting the HIV-infected patient is often not possible and US is sometimes relied upon as a "diagnostic" investigation by many physicians. Further studies are required to define patterns of clinical findings, plain films, and pathologic and laboratory correlates with US to develop and refine diagnostic algorithms for clinical use in resource-poor countries.

Key words: AIDS—HIV—Central Africa—Abdominal ultrasound—Diagnosis—Radiologist.

In patients infected with the human immunodeficiency virus (HIV), the gastrointestinal tract and abdominal viscera are frequently affected by localized or systemic infectious and noninfectious complications [1–7]. In the United State and Europe, imaging by ultrasound (US) and

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Table 1. Primary clinical indications for diagnostic abdominal ultrasound referral in Central African adults

Hospital, city	UTH, Lusaka		Gecamines Sendwe, Lubumbashi		Both sites	
HIV status	HIV+	HIV−	HIV+	HIV−	HIV+	HIV−
Number	600	600	300	300	900	900
Indication	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)
Abdominal pain	242 (40)	251 (42)	114 (38)	133 (44)	356 (40)	384 (43)
Fever of unknown origin	178 (30)	162 (27)	80 (27)	67 (22)	258 (29)	229 (25)
Hepatomegaly or splenomegaly or both	159 (26)	102 (17)	68 (23)	75 (25)	227 (25)	177 (20)
Peripheral lymphadenopathy with systemic signs	142 (24)	85 (14)	56 (19)	31 (10)	198 (22)	116 (13)
Abnormal liver function tests	91 (15)	64 (11)	79 (26)	56 (19)	170 (19)	120 (13)

Table 2. Abdominal ultrasound findings in 1,800 Central African adults[a]

Hospital, city	UTH, Lusaka		Gecamines Sendwe, Lubumbashi		Both sites	
HIV status	HIV+	HIV−	HIV+	HIV−	HIV+	HIV−
Number	600	600	300	300	900	900
Ultrasound abnormality	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)
Splenomegaly	231 (38)	147 (24)	84 (28)	72 (24)	315 (35)	219 (24)
Hepatomegaly	224 (37)	134 (22)	93 (31)	63 (21)	317 (35)	197 (22)
Lymphadenopathy	201 (33)	63 (10)	79 (26)	33 (11)	280 (31)	96 (11)
Biliary tract abnormality	154 (27)	70 (12)	72 (24)	39 (13)	226 (25)	109 (12)
Gut wall thickening	97 (16)	28 (5)	42 (13)	21 (7)	139 (15)	49 (5)
Free fluid (ascites)	140 (23)	60 (10)	54 (18)	24 (8)	194 (22)	84 (9)
Renal abnormalities	58 (10)	43 (7)	37 (12)	24 (8)	95 (11)	67 (7)
Pancreatic abnormalities	51 (8)	40 (7)	30 (10)	29 (8)	81 (9)	69 (8)

[a] Some patients had more than one feature on US examination

computed tomography (CT) has been shown to be useful in the diagnosis and management of patients with the acquired immunodeficiency syndrome (AIDS) [8–16]. Due to scarce resources, CT is not available in many developing countries. When available, imaging of the abdomen in resource-poor tropical countries is restricted to barium studies and abdominal US. These facilities may provide useful information for the detection of intrabdominal disease and in the assessment of response to specific treatment. To study the abdominal US findings in HIV+ Central African patients and to determine whether the findings were consistent between different population groups and neighboring countries, we undertook a prospective study of Congolese and Zambian adults with AIDS as defined by the Centers of Disease Control and Prevention (CDC) criteria [17] and referred for the imaging procedure. The abdominal US findings in 900 HIV-infected adults with a diagnosis of AIDS seen at two Central African Hospitals are presented, and these features are compared with abdominal US findings of 900 HIV-seronegative adults referred with similar symptoms.

Patients and methods

Between 1992 and 1996, abdominal US was performed in 900 adults (age range = 15–55 years) with a diagnosis of AIDS who were referred from the inpatient medical wards to the radiology department for diagnostic imaging. Of these patients, 58% were male, with a mean age of 30 years (range = 15–55 years), and 42% were female, with a mean age of 27 years (range = 16–49 years). The following numbers of adults from each hospital underwent abdominal US examination: (a) 300 from the Gecamines Sendwe Hospital (GSH), Lubumbashi, Congo, seen between January 1992 and December 1993, and (b) 600 from the University Teaching Hospital (UTH), Lusaka, Zambia, seen between January 1994 and December 1996. During the same period, 900 consecutive abdominal US examinations performed on HIV-seronegative adults were chosen as comparative age- and sex-matched controls (600 from UTH, 300 from CGH). Of these patients, 56% were male (age range = 16–58 years), with a mean age of 33 years, and 44% were female (age range = 15–50), with a mean age of 30 years.

The indications for referral for diagnostic imaging were recorded. All US examinations were interpreted by the same two consultant radiologists at each referral hospital. The presence of the following abnormalities were noted: splenomegaly, with or without hypo- or hyperechoic lesions; hepatomegaly, with or without single or multiple focal lesions; lymphadenopathy; gallbladder and bile duct abnormalities; gut wall thickening; ascites (free fluid); renal abnormalities, with diffusely increased echogenicity; and pancreatic findings, made of diffuse enlargement and hypoechogenicity of the gland. The following definitions were used: lymphadenopathy, with lymph nodes larger than 2 cm in diameter; splenomegaly, with the spleen larger than 13 cm at its longest axis; hepatomegaly, with the liver measuring more than 15 cm at its longitudinal axis; and gut wall thickness, where greater than 5 mm was considered abnormal. US examinations were performed by using commercially available, high-resolution, real-time imaging units. Data obtained were analyzed by using the EPI-INFO software program using chi-square analysis. HIV testing at the two hospitals was performed with two enzyme-linked immunosorbant assay tests (Wellcozyme, Wellcome Diagnostics, Dartford, Oxford, UK; and the antiglobulin recombinant form, DuPont de Nemours, Wilmington, DE, USA). Those sera that produced indeterminate results were subjected to Western blotting. The CDC criteria for the diagnosis of AIDS were used.

Results

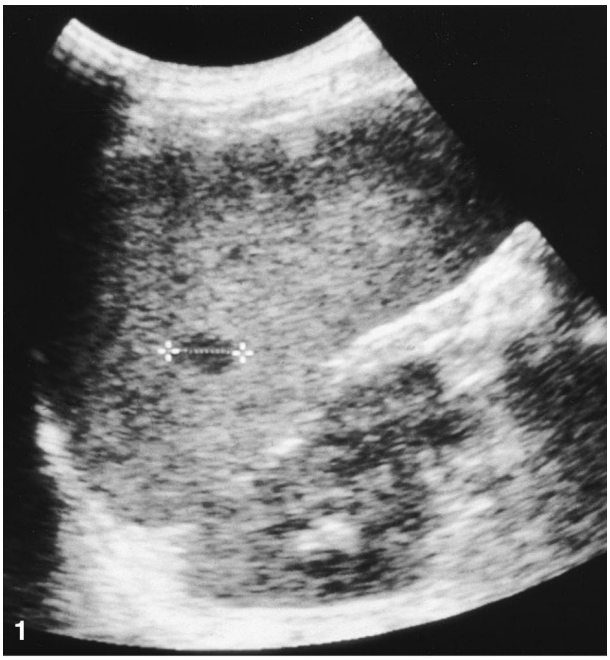
Table 1 lists the clinical indications for which an abdominal US was requested in 900 AIDS patients and 900 HIV-seronegative adults. Some of the patients had more than one of the five indications for referral: (a) abdominal pain, (b) fever of unknown origin, (c) hepatosplenomegaly, (d) abnormal liver function tests, and (e) peripheral lymphadenopathy with systemic symptoms. The significant abdominal US findings seen are shown in Table 2. The US findings were similar overall and at each hospital.

Splenomegaly, with single or multiple focal lesions

Splenic enlargement was common in both groups, although it was more common in patients with AIDS; 315 of 900 (35%) of the AIDS group had splenomegaly compared with 219 of 900 (24%) of the HIV− group ($p \leq 0.001$). The patterns seen were similar in patients from UTH and GSH. Splenic involvement by lymphoma was commonly seen in association with splenomegaly (Fig. 1).

Hepatomegaly, with or without hypo- or hyperechoic nodules

Enlargement of the liver was significantly more common in AIDS patients: 317 of 900 (35%) versus 197 of 900 (22%; $p \leq 0.001$). In both groups, hepatomegaly was due to either mass and granulomatous lesions (Fig. 2) or nonspecific findings such as fatty infiltration of the liver. Liver biopsy was not routinely performed in all AIDS patients with hepatomegaly. In the AIDS group, there were 42 biopsy results available from individuals who had detectable parenchymal lesions, and a US-guided liver biopsy was esssential to making the diagnosis: there were 14 cases of tuberculosis (seven with caseating granuloma and seven with cultured *Mycobacterium tubercu-*



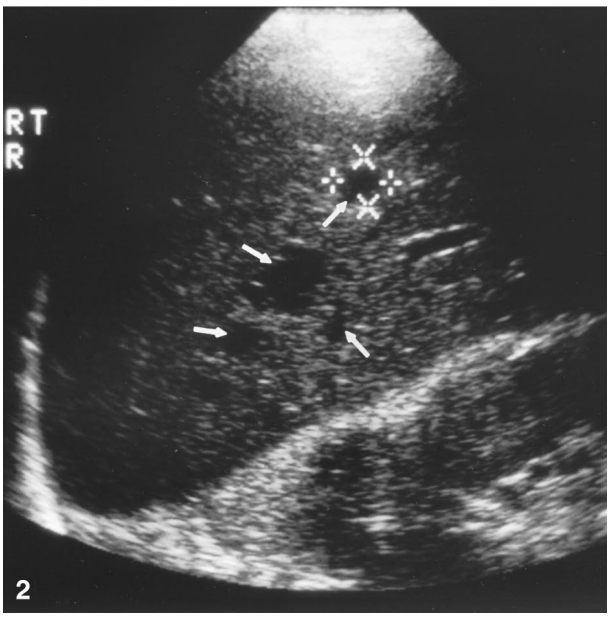


Fig. 1. Splenic involvement in AIDS-related biopsy-proven non-Hodgkin's lymphoma. A longitudinal sonogram of the enlarged spleen demonstrates a single hypoechoic lesion of homogeneous echo pattern (between gradicules) measuring 13.78 mm in diameter.

Fig. 2. Multifocal hepatic involvement by *Mycobacterium tuberculosis* in a 20-year-old patient with AIDS. A longitudinal sonogram of the enlarged liver shows several hypoechoic lesions in the right lobe of the liver (*arrows*), representing tuberculous abscesses. The diagnosis was confirmed by culture of percutaneous biopsy material.

Table 3. Gallbladder and bile duct findings on abdominal US examination[a]

Hospital, city	UTH, Lusaka		Gecamines Sendwe, Lubumbashi		Both sites	
HIV status	HIV+	HIV−	HIV+	HIV−	HIV+	HIV−
Number of cases	54	80	72	39	224	109
Gallbladder and bile duct abnormality	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)
Gallbladder wall thickening	122 (79)	36 (51)	52 (72)	15 (38)	174 (77)	51 (47)
Bile duct dilatation	68 (44)	26 (37)	42 (58)	22 (56)	110 (49)	48 (44)
Cholelithiasis	39 (25)	48 (68)	13 (18)	27 (66)	52 (23)	75 (69)

[a] some patients had more than one abnormality

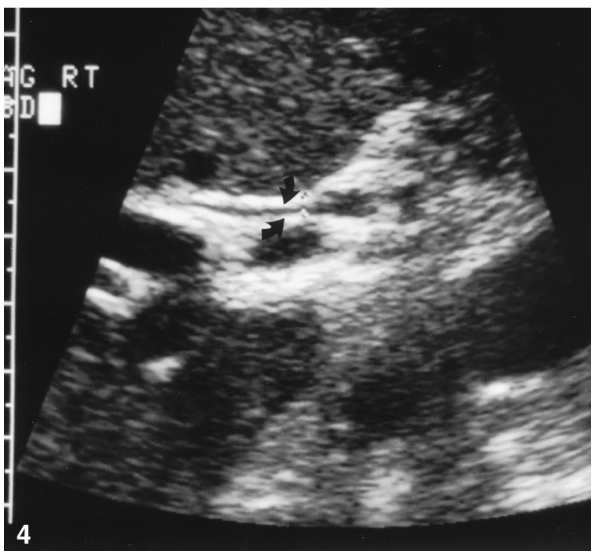


Fig. 3. Cholecystitis secondary to cryptosporidium infection. Transverse and longitudinal (not shown) sonograms in this 35-year-old AIDS male patient demonstrate diffuse gallbladder wall thickening (*white arrows*). There was cholelithiasis (*black arrows*), and a sonographic Murphy sign was noted at the time of abdominal US. The biliary tree was normal.

Fig. 4. Cholangitis due to cryptopsoridium infection. Sonogram demonstrates infiltration of the distal common bile duct that appears markedly thickened and echogenic (*arrows*). The thickening of the bile duct likely compromises the ductal lumen.

losis from a nongranulomatous mononuclear infiltrate), four of nongranulomatous mycobacterial infection, four of acute bacterial sepsis (two with *Salmonella* spp), one of cryptococcus, seven of hepatocellular carcinoma, six of non-Hodgkin's lymphoma, two of Kaposi's sarcoma, two of schistosomiasis, and one of cytomegalovirus inclusions.

Gallbladder and bile duct abnormalities

The AIDS group had significantly more common abnormalities of the gallbladder and bile duct than did the HIV-seronegative groups. In all cases, the abnormalities were associated with hepatomegaly: 226 of 900 (25%) of AIDS patients versus 109 of 900 (12%) HIV-seronegative patients ($p \leq 0.001$). Similar observations were made at each hospital. Table 3 shows the gallbladder US findings. Gallbladder wall thickening (Fig. 3) was noted in 77% of the AIDS cases at UTH and in 72% cases at GSH. Extrahepatic bile duct infiltration (Fig. 4) and dilatation was seen in 68 of 154 (44%) of Zambian patients at UTH versus 42 of 72 (58%) Congolese AIDS patients. Gallstones were seen in both AIDS and HIV-seronegative groups but were significantly less common in the AIDS patients (23% vs. 75%; $p \leq 0.001$).

Lymphadenopathy

Retroperitoneal and mesenteric lymphadenopathies (Fig. 5) were seen more commonly in the AIDS group at both hospitals; 280 of 900 (31%) AIDS patients showed lymphadenopathy versus 96 of 900 (11%) in the HIV-seronegative group ($p \leq 0.001$). Similar results were obtained from each hospital: 201 of 600 (33%) in the AIDS group versus 63 of 600 (10%) in the HIV-seronegative group ($p \leq 0.001$) at the UTH in Lusaka, and 79 of 300 (26%) versus 33 of 300 (11%; $p = 0.001$), respec-

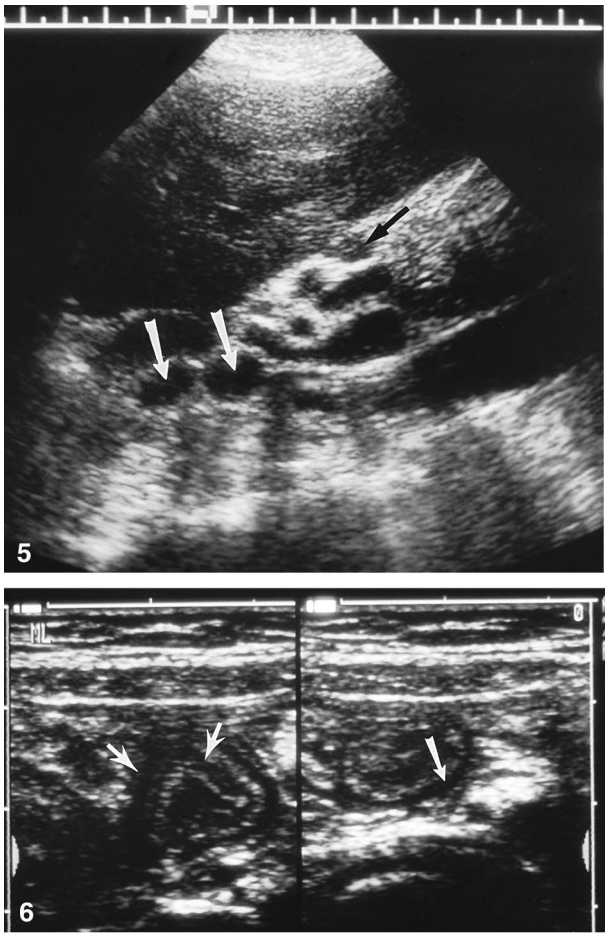


Fig. 5. Enlarged retroperitoneal nodes (*arrows*) in a 28-year-old male patient with HIV infection. The enlarged nodes are shown as hypoechoic round masses of different sizes in the paraaortic area (*white arrows*) and peripancreatic zone (*black arrow*). The differential diagnosis included Kaposi's sarcoma, non-Hodgkin's lymphoma, and mycobacterial infection. *Mycobacterium tuberculosis* was demonstrated by fine-needle aspiration biopsy of concomitant peripheral adenopathy. The patient was treated with antitubercular drugs for 8 months. US follow-up showed obvious regression of the disease.

Fig. 6. Transverse sonograms of diffusely thickened bowel loops (*arrows*) in a 38-year-old female patient with AIDS and cytomegalovirus colitis.

tively, at GSH, Lubumbashi. US-guided abdominal lymph node biopsies are not frequently performed at the two hospitals. In 88 of these AIDS patients, available results of biopsy of peripheral lymph nodes showed lymphoid hyperplasia of HIV infection (51 cases), tuberculosis (21 cases), non-Hodgkin's lymphoma (six cases), Hodgkin's lymphoma (three cases), toxoplasmosis (one case), and nonspecific chronic inflammatory changes (six cases).

Duodenal and bowel wall thickening

Thickened bowel wall (Fig. 6) was seen in 139 of 900 (15%) of the AIDS group versus 49 of 900 (5%; $p = 0.001$) in the HIV-seronegative group. The patterns seen were similar in patients from UTH and GSH. The wall thickening included circumferential and focal wall thickening.

Free fluid (ascites)

Free fluid (Fig. 7) within the abdomen was seen more frequently in the AIDS group at both hospitals: 194 of 900 (22%) in the AIDS group versus 84 of 900 (9%) in the HIV-seronegative group ($p \leq 0.001$).

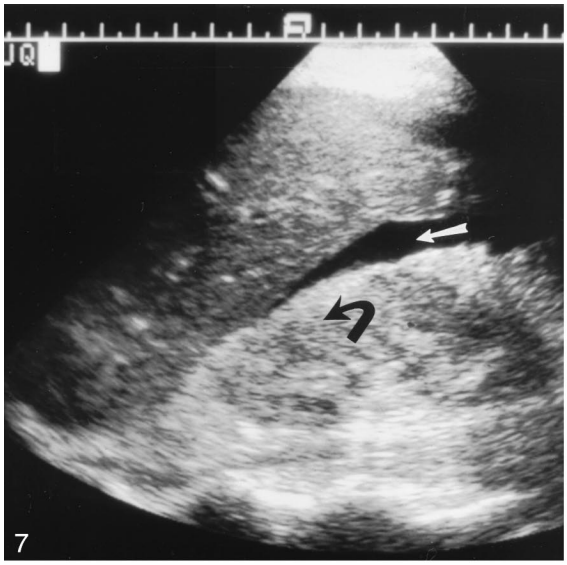
Renal and pancreatic abnormalities

Renal US findings were diverse, and there were no significant differences between the AIDS and HIV-seronegative groups at both hospitals. Increased echo texture of the cortex, medulla, or both in rather enlarged kidneys (Fig. 7) was described. Other findings were hydronephrosis, nephrolithiasis, renal tumors, and chronic pyelonephritis. Pancreatic abnormalities included diffuse hypoechoic pattern of a slightly enlarged gland (Fig. 8). There were no significant differences between the AIDS and HIV-seronegative groups overall at both hospitals.

Discussion

AIDS has now reached epidemic proportions in all sub-Saharan African countries. The health services of Central African countries are overwhelmed with the infectious and noninfectious complications that occur in the HIV-infected patient. Accurate diagnosis is often impossible in most regions of Central Africa because of the lack of diagnostic facilities. In the absence of CT scanning facilities, abdominal US is the next best available alternative for investigating disease involvement of the gut and other abdominal viscera in patients infected with HIV [8–16]. Although US does not provide a definitive diagnosis, it may show areas of abnormal anatomy and pathology that may facilitate achieving a tissue diagnosis or add further support to decisions on commencing empiric treatment. This is the first radiologic study from Central Africa that compares the abdominal US findings of AIDS patients with HIV− adults from two Central African teaching hospitals from neighboring countries.

Physicians in Zambia and Congo currently request abdominal US for a variety of clinical indications. Our study illustrates that abdominal pain, pyrexia of unknown origin, enlarged liver and spleen, peripheral lymphadenopathy with systemic symptoms, and abnormal liver function tests are the common indications for referral for



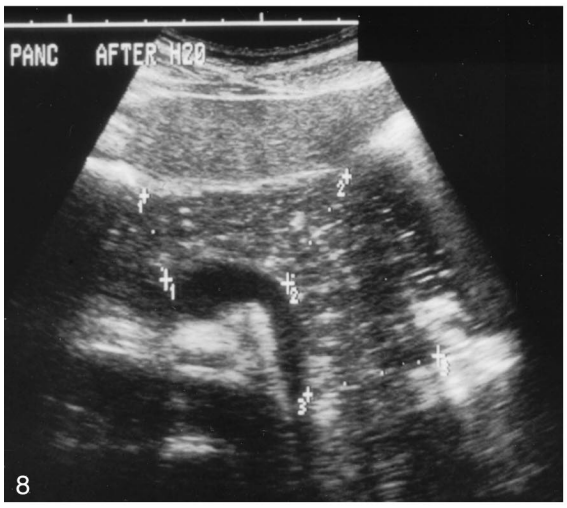


Fig. 7. AIDS nephropathy in an 18-year-old female patient seen at UTH. Longitudinal sonogram of the right kidney shows a markedly increased renal echogenicity and loss of corticomedullary differentiation (*curved arrow*). Originating from the medulla, the curved arrow points to the renal cortex. There is no hydronephrosis or parenchymal scarring. Note the presence of moderate ascites in the hepatorenal space (*straight arrow*).

Fig. 8. Diffusely enlarged pancreas (between the plus signs) showing a hypoechoic and inhomogeneous texture in a nonalcoholic 36-year-old AIDS patient with acute pancreatitis.

diagnostic US in AIDS patients from the medical wards. A wide range of abdominal US findings is seen in both the AIDS and HIV− groups. Comparison of the two groups showed that the AIDS group of patients had a significantly higher proportion of lymphadenopathy, splenomegaly, liver enlargement, gut wall thickening, free fluid, and gallbladder abnormalities. There were no differences in renal and pancreatic abnormalities between the AIDS and HIV− groups. Whereas gallbladder abnormalities were seen more frequently in the HIV+ group, gallstones were seen significantly less frequently in the AIDS group. We found similar findings at both hospitals and in both patient groups; thus, the patterns seen are probably common to all sub-Saharan African countries.

There are no similar studies from Africa with which to compare our results. A study involving US of the abdomen of 399 AIDS patients in British Columbia [12] showed a high percentage of splenomegaly (31%), lymphadenopathy (21%), gallbladder and bile duct abnormalities (20%), hepatomegaly (19%), and ascites (13.5%). As in our study, renal and pancreatic abnormalities were less frequent. Lymphadenopathy and hepatosplenomagly appear to be more common in Central African AIDS patients, which may reflect the high background incidence of parasitic and infectious diseases in sub-Saharan Africa.

Taken together, the available data suggest that the atypical changes seen on abdominal US of many AIDS patients appear uniform across countries in sub-Saharan Africa. However, a wide range of features is seen in both AIDS and HIV-seronegative individuals. The absence of clinicopathologic data due to scarcity of resources in developing countries makes the sensitivity and specificity of US difficult to assess. This may have implications for the radiologist, especially in developing countries, where accurate microbiological or pathologic diagnosis of infectious and noninfectious diseases afflicting the HIV-infected patient is often not possible and US is sometimes relied upon as a "diagnostic" investigation by many physicians. Reports from the United States and Europe have shown that a combination of US findings and clinical features may help in the diagnosis of specific clinical conditions such as disseminated tuberculosis [11, 14, 15] and sclerosing cholangitis [9]. Further studies are required to develop and refine diagnostic algorithms using clinical and radiologic findings and pathologic and laboratory parameters with diagnostic US features for use in resource-poor countries.

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