37 Abdominal Tuberculosis

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Tuberculosis remains one of the major health problems in the world. WHO estimates that each year 8 million new cases of tuberculosis occur and approximately 3 million people die from the disease (WHO 1996). Tuberculosis is a disease of developing countries; however, its incidence is increasing in developed countries as well, mainly in the immigrant population and in patients with AIDS (McKenna et al. 1995; Barnes et al. 1991).

37.1 Epidemiology

Abdominal tuberculosis is still prevalent in developing countries (Tandon and Prakash 1972; Bhansali 1977; Kapoor 1998). There is confusion on the exact incidence of abdominal tuberculosis in such countries due to problems of actual reporting, difficulty in diagnosis, and inability to separate tuberculosis from Crohn's disease, which can closely resemble it in its clinical manifestations. Abdominal tuberculosis was common in the United States early in the 20th century (Horvath and Whelan 1998). It was the cause of most cases of small intestinal obstruction and stricture. However, by the middle of the century all forms of tuberculosis had declined dramatically. This decline was caused by a number of factors, which included an increased standard of living, pasteurization of milk, control of bovine tuberculosis. and introduction of antituberculous treatment (O'Reilly and Daborn 1995). In fact, frequency of abdominal tuberculosis in the United States in 1960s and 1970s dropped to such low levels that the disease was classified as a "rare" or Third World disease. However, since 1985 the number of reported cases of abdominal tuberculosis has dramatically increased. This was due to two reasons: (1) an increased incidence of all cases of tuberculosis (Brudney and Dobkin 1991; Cantwell et al. 1994) and (2) an increased proportion of extrapulmonary disease, especially abdominal tuberculosis (Farer et al. 1979; Alvarez and McCabe 1984). From 1980 onward, reported cases of tuberculosis in the United States dramatically increased. The majority of these cases were in Hispanics, blacks, prisoners, immigrants, refugees, and nursing home patients (McKenna et al. 1995; Cantwell et al. 1994; Nardell et al. 1986; Raviglione and O'Brien 2001; Bradney and Dobkin 1991). Multidrug-resistant tuberculosis in AIDS patients contributed significantly to this increase in the occurrence of the disease (Edlin et al. 1994; Bloch et al. 1994; Gordin et al. 1996; Frieder et al. 1993; Selwyn et al. 1989; CDC 1990, CDC 1991; Small et al. 1993; Anand 1956). The impact of the disease was seen particularly in urban areas. In 1979, there were 1,530 new cases of tuberculosis in New York City, and by 1991 the city had 3,673 new cases of tuberculosis, a yearly increase that is three times the national average. The number of cases continued to increase and peaked in 1992. As a result of aggressive health care control policies, the number of cases has shown a gradual downward trend.

Another reason for high occurrence of abdominal tuberculosis was high proportion of extrapulmonary disease (Farer et al. 1979; Alvarez and McCabe 1984). In 1960 s only 8% of patients with tuberculosis had extrapulmonary manifestations. By 1986, extrapulmonary disease constituted 25% of all cases of tuberculosis. The lung is the commonest site (over 85%) of

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involvement in immunocompetent persons, while the disease predominantly affects extrapulmonary sites (over 50%) in patients with AIDS. As the urban epidemic of tuberculosis in the United States occurred in AIDS patients, abdominal tuberculosis revealed a significant resurgence.

Mycobacterium tuberculosis is the pathogen for most cases of abdominal tuberculosis. *Mycobacterium bovis*, an organism transmitted by unpasteurized diary products, is the cause of a small percentage of cases in developing countries (Raviglione and O'Brien 2001; Marshall 1993).

The route of infection occurs by one of the following mechanisms (Kapoor 1998; Horvath and Whelan 1998; Marshall 1993):

1. Swallowing of infected sputum. This occurs in patients with sputum-positive pulmonary disease and those with laryngeal involvement. This was the most important route of infection before the era of effective treatment. Autopsies in patients with pulmonary tuberculosis in the pretreatment era demonstrated intestinal disease in 55% to 99%. The frequency of intestinal disease was related to the severity of pulmonary involvement: 1% of patients with minimal pulmonary tuberculosis, 4.5% with moderately advanced disease, and 25% with far-advanced disease. In modern series, this mode of infection is less important and chest radiograph is completely normal in the majority of patients with intestinal tuberculosis.
2. Hematogenous spread from active pulmonary, miliary tuberculosis or silent bacteremia during the primary phase of tuberculosis. Most cases of abdominal tuberculosis occur as a result of reactivation of a latent focus in the small bowel or peritoneum. This focus is established perhaps previously, because of hematogenous spread from a primary focus in the lungs that subsequently healed completely (as they usually do without leaving any radiologic evidence of a lung lesion). Less commonly, hematogenous spread can occur from active pulmonary focus tuberculosis. Hepatosplenic tuberculosis almost always follows miliary seeding and is a manifestation of dissemination throughout the body.
3. Ingestion of contaminated milk or milk products. This mode of infection had been a common cause of spread of bovine tuberculosis in the past. However, pasteurizing and/or boiling milk has controlled this mode of transmission (O'Reilly and Daborn 1995). At present, *Mycobacterium bovis* is involved in a small percentage of intestinal disease in developing countries, and this form of disease is rare in the West (Anand 1956).
4. Contagious spread from adjacent organs. Occasional cases of abdominal tuberculosis are related to contagious spread from tuberculous lesions of adjacent organs. Peritoneal spread can occur from lesions in the fallopian tubes and intestines. Recent data showed that this is an infrequent mechanism in most patients with abdominal tuberculosis. More often, lymph node lesions spread the infection to the bowel wall or pancreas.
5. Tuberculosis in patients with AIDS. Tuberculosis occurs with increased frequency in AIDS patients as the CD4 count drops below 400 cells per μl (Jones et al. 1993). An autopsy study in West Africa found that 50% of adults dying of AIDS had active tuberculosis and in 85% of them the liver was involved. In fact tuberculosis is the most common specific hepatic HIV-associated lesion in such patients (Lucas 1994). The pathology of tuberculosis varies with the immune status of the patient (Bhargava et al. 1984; Edwards and Kirkpatrick 1986). In patients with intact immune systems, granulomas with Langhans giant cells and caseation or non–giant cell epitheloid granulomas are usually seen. In patients with extreme immune deficiency as commonly seen in terminal AIDS patients, the histologic pattern is that of nonreactive tuberculosis. Foci of granular necrosis are surrounded by degenerate swollen macrophages, and a large number of acid-fast bacilli are seen. An analysis using restriction-fragment-length polymorphisms to study the mode of infection of tuberculosis in patients with AIDS has shown that the disease is readily spread from index patients and progresses rapidly to active disease. There was no evidence that disease occurs from reactivation of a latent focus (Daley et al. 1992; Small et al. 1994).
6. Liver disease and tuberculous peritonitis. Patients with cirrhosis of the liver with ascites have a higher chance (around 10%) of concomitant tuberculous infection (Aguado et al. 1990). In the United States, half of the patients with tuberculous peritonitis have underlying alcoholic cirrhosis as a cause of ascites formation (WHO 1990; Raviglione and O'Brien 2001; Lucas 1994). The mechanism of this infection in patients with liver disease in not known. It may be due to reactivation of a latent tuberculous focus in the peritoneum facilitated by lower immunity and coexistent ascites.
7. Tuberculous peritonitis in patients undergoing long-term or continuous ambulatory peritoneal

dialysis (CAPD). Tuberculous peritonitis has been reported as a complication of CAPD (Holley and Piraino 1990; Cheng et al. 1989; Lui et al. 1996; Lam et al. 2000). Talwani and Horvath (2000) reviewed the English-language literature and found 51 reported cases of CAPD-associated tuberculous peritonitis and added a 52nd case from their own experience (Lui et al. 1996). Defects in local immunity unique to CAPD may predispose to active tuberculosis in such patients. Removal of the CAPD catheter is not considered necessary for cure of the infection.

Abdominal tuberculosis can occur at any age and is equally prevalent in males and females (Bhansali 1977; Kapoor 1998; Horvath and Whelan 1998). The majority of patients have symptoms present for 1 month to 1 year; however, around 20% of patients have symptoms for 1 month or less at the time of presentation. Low-grade fever, night sweats, anorexia, weight loss, general lassitude, and weakness occur in around two thirds of patients. Symptoms of disease at other sites occur in patients with active disease in extraabdominal organs. This is of particular significance in patients with active pulmonary tuberculosis or disseminated tuberculosis. Laboratory results reveal mild normocytic or microcytic anemia and normal white blood cell count (Pouchot et al. 1997). PPD is positive in most of the patients; however, it may be negative in immunosuppressed and malnourished patients (Bass et al. 1985; Huebner et al. 1993; American Thoracic Society 1981; Markowitz et al. 1993). Chest X-rays show active disease in about one fifth of patients.

The evolution of the disease in a patient with abdominal tuberculosis depends upon route of infection, site of involvement, and underlying immune status of the subject. Abdominal tuberculosis may affect the gastrointestinal tract, peritoneum, lymph nodes, liver and spleen and pancreas singly or in combination. Abdominal tuberculosis in immunosuppressed patients poses special problems as disease has distinct bacteriologic and clinical characteristics. Gastrointestinal tuberculosis affects, in order of frequency, the ileocecal region, jejunum/ileum, colon, anorectum, stomach, appendix, duodenum, and esophagus (Marshall 1993). Reported sites of involvement of abdominal tuberculosis are shown in Fig. 37.1.

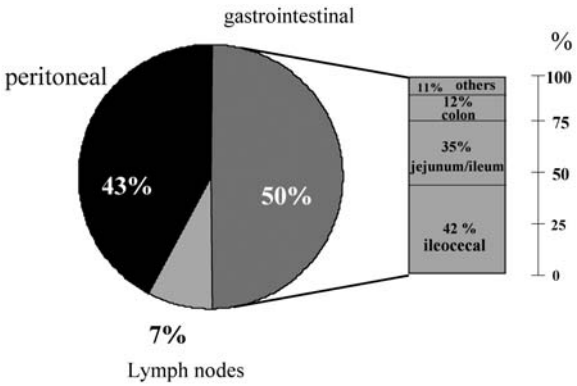


Fig. 37.1. Sites of organ involvement in abdominal tuberculosis. The data are based on 596 patients with abdominal tuberculosis

37.2 Tuberculosis of Small Bowel and Colon

Pathogenesis (Tandon and Prakash 1972; Anand 1956). After the tubercle bacilli enter the gastrointestinal tract, they traverse the mucosa to lodge in the submucosa. There, the presence of the bacilli induces inflammatory changes, including serosal and subserosal edema, cellular infiltrate, and lymphatic hyperplasia. Eventually, the appearance of granulomata causes small papillary mucosal elevations. Lymphangitis, endarteritis, and fibrosis ensue, which lead to mucosal ulceration, caseating necrosis, and narrowing of the intestinal lumen. Mucosal ulceration may occur as a result of endarteritis of submucosal vessels. Infection can spread to mesenteric lymph nodes.

As mentioned earlier, the most common site of involvement is the ileocecal region. The affinity of the bacilli for this site may be due to its relative stasis and abundant lymphoid tissue. The macroscopic appearances of intestinal lesions can follow one of the below-mentioned patterns. Such lesions are usually segmental, and multiple sites of involvement are common. Rarely, diffuse colonic involvement may simulate ulcerative colitis and Crohn's disease. Other characteristics include increased mesenteric fat and mesenteric lymphadenopathy, which can cause traction diverticula with narrowing, local fixation, and sinus tract development.

a. An ulcerative lesion is characterized by multiple superficial ulcers. Ulcers are circumferential and usually surrounded by inflamed mucosa. This is the most common lesion, occurring in around 60% of such patients and is associated with a virulent clinical course.
b. A hypertrophic lesion is characterized by scarring, fibrosis, and pseudotumor formation. This is seen in around 10% of such patients.

c. An ulcerohypertrophic lesion is characterized by an inflammatory mass with thickened and ulcerated mucosa. The lesion is most commonly seen in the ileocecal region. It causes cone-shaped deformity of the cecum, shortening of the ascending colon, and thickening of the ileocecal valve, where a wide gape is created. Overall this lesion is seen in 30% of such patients.
d. Fibrous stricture occurs in some patients as a result of healed ulceration causing luminal narrowing and gut obstruction. In some cases this occurs after effective antituberculous therapy. Luminal narrowing may also occur due to extraintestinal lymph node involvement without intrinsic intestinal lesions.

Clinical Manifestations. Abdominal symptoms depend upon the site of involvement of disease, pattern of pathologic changes, and underlying immunologic status of the host (Bhansali 1977; Kapoor 1998; Horvath and Whelan 1998; Marshall 1993). Involvement of small bowel and colon leads to single or multiple strictures through a number of underlying pathogenic mechanisms (see as above). Abdominal pain in such patients is characteristically described as a "ball of wind" moving around the umbilicus. It is associated with abdominal distension, inability to pass wind, and borborygmi. Following an episode of pain, diarrhea usually ensues. Steatorrhea and significant weight loss can occur due to bacterial overgrowth. Right lower quadrant mass and pain can occur in patients with hypertrophic ileocecal tuberculosis. Rarely, diffuse colonic disease can simulate symptoms of ulcerative colitis. Perforation and fistulae occur in a small percentage of patients. Massive bleeding from the lesion in the gut has been reported. Clinical examination reveals distended bowel loop and exaggerated bowel sounds. Plain X-ray of the abdomen reveals distended bowel loops with multiple fluid levels.

Diagnosis. Intestinal tuberculosis can be difficult to diagnose. The reasons for this include absence of a particular pattern of symptoms and signs. In fact, symptoms of the disease may be vague and signs nonspecific. Thus, a high degree of suspicion is needed. Even with adequate imaging, endoscopic examination and bacteriologic tools, diagnosis can correctly be made in only around 50% of patients with intestinal tuberculosis. The dominant reason for this is the inaccessibility of common sites of disease segments of the bowel, namely the ileum and ileocecal region. Moreover, the hallmark of tuberculous pathology, namely caseating granulomas, may be absent in the bowel wall and present in the draining lymph nodes (Tandon and Prakash 1972; Anand 1956). Laparotomy and resection of the involved segments with culture and animal inoculation of the organisms have been performed to make a diagnosis with precision in endemic areas. Therapeutic trial with antituberculous drugs is commonly used in developing countries to make a diagnosis.

A number of clinical conditions closely simulate intestinal tuberculosis. These include Crohn's disease, amebiasis, carcinoma colon, *Yersinia enterocolitis*, gastrointestinal histoplasmosis, and periappendiceal abscess. A number of features may help to differentiate intestinal tuberculosis from Crohn's disease and *Yersinia* infection. These have been detailed in Table 37.1.

The diagnostic algorithm to be followed for intestinal tuberculosis may vary with the exact site of disease involvement (Fig. 37.2). X-ray chest, PPD skin test, and flat abdominal films are usually used for the

Table 37.1. Differentiating features of abdominal tuberculosis from Crohn's disease and Yersinia infection

Feature	Tuberculosis	Crohn's disease	Yersinia enterocolitica
Clinical course	Prolonged	Long intermittent	Several weeks
Stool culture	Negative	Negative	Positive
Serology for Yersinia	Negative	Negative	Positive
PPD	Positive	Negative	Negative
X-ray of chest	Positive	Negative	Negative
Ileal disease	Short	Long	Short
Ulcers	Circumferential	Linear	Normal endoscopy
Fistulae	Unusual	Common	Nil
Granulomas	Large, many, caseating	Small, few, noncaseating	Intramural, multiple, large, with satellite Abscess
Anal lesions	Rare	Frequent	Nil
Strictures	Usually <3 cm	Long	Localized
Nodal involvement	Often, independent of mural disease	Only with transmural disease	In children with ileitis

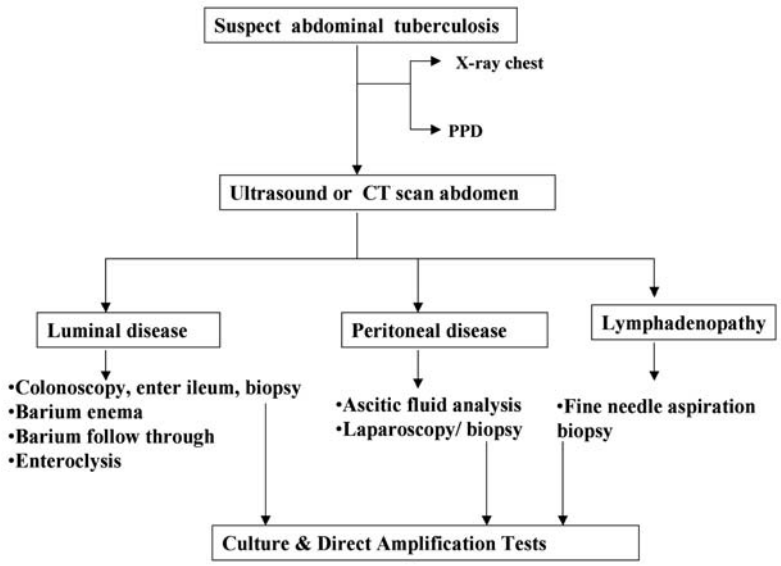


Fig. 37.2. An algorithm which is useful to investigate most cases of abdominal tuberculosis

initial investigations. Active pulmonary disease may help; however, it is seen in only a minority of patients. PPD skin test is positive in the majority of patients with abdominal tuberculosis, but is of limited value because it does not differentiate between active disease and previous exposure or vaccination. Furthermore, the PPD skin test may be negative in older or immunosuppressed patients (Lui et al. 1996; Lam et al. 2000). Careful examination of the flat abdominal films may give important clues to the nature and site of underlying pathology. Calcification of lymph nodes is of the speckled type, and rarely calcification of peritoneum may coexist. Episodes of abdominal pain are usually associated with dilated bowel loops with air fluid levels proximal to the site of stricture.

Abdominal imaging by ultrasound, computed tomography, or magnetic resonance imaging is useful to define the bowel wall, abdominal lymph nodes, and changes in peritoneum, mesentery, and omentum. CT, with its ability to provide a comprehensive overview of abdominal structures, is the imaging modality of choice for such evaluations (Suri et al. 1999; Balthazar et al. 1990; Ha et al. 1999). The most common CT findings are mural thickening affecting the ileocecal region, either limited to the terminal ileum or cecum or, more commonly, simultaneously involving both regions (Fig. 37.3, *chapter X Fig 10, 12*). This mural thickening is usually concentric, but is occasionally eccentric, and it predominantly affects the medial wall. In some patients, low-density areas, most likely to represent necrosis, may be noted within the thickened wall. Ileocecal involvement is usually associated with enlarged hypodense nodes in the adjacent mesentery. Skip areas of concentric mural thickening may be seen elsewhere in the small bowel, usually affecting the ileal loops. These segments may also show luminal narrowing with or without proximal dilatation. The presence of such lesions in com-

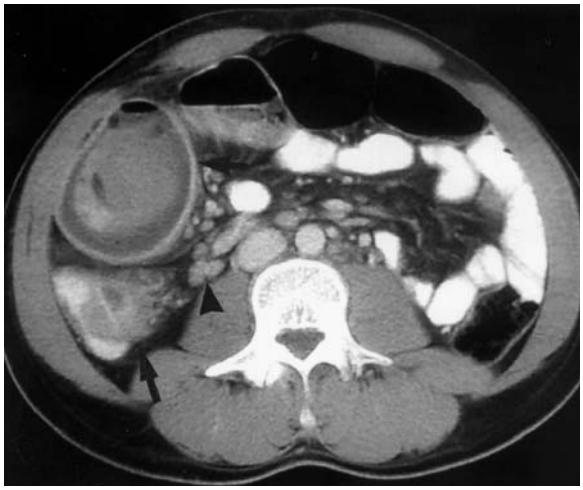


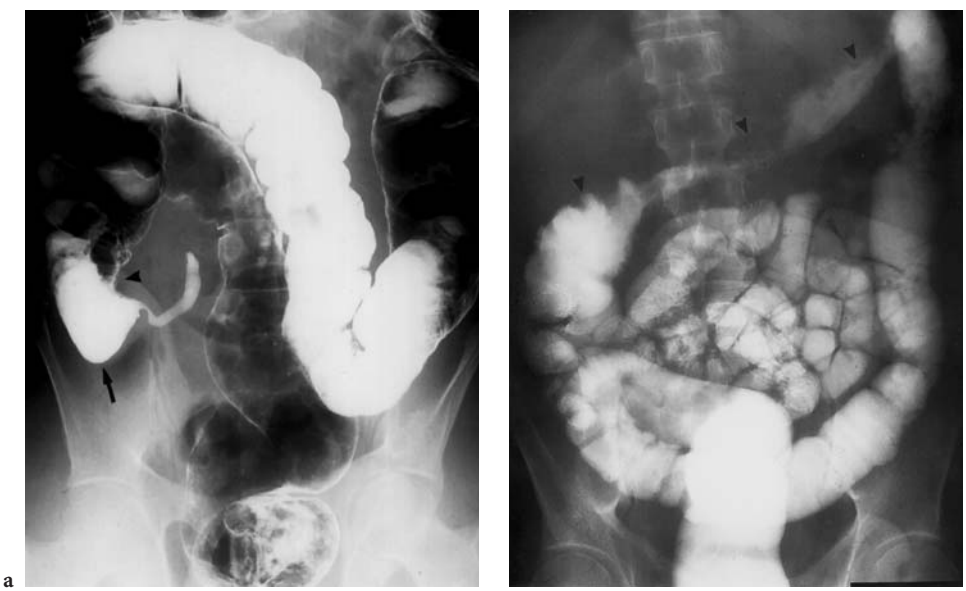
Fig. 37.3. Tuberculosis of colon. A 28-year-old male presenting with fever, abdominal pain, and loose motions of 18 months duration. He had a strong history of contact with an open case of pulmonary tuberculosis. General physical examination was unremarkable. Abdominal examination revealed fullness and vague tender mass in the right iliac fossa. ESR was 10 mm and PPD skin test was 7 mm. Plain X-rays of chest and abdomen were normal. Computed tomography of abdomen with oral and IV contrast shows thickened cecum *(short arrow)*, a mass below the cecum *(long arrow)* and 2 lymph nodes of 1 cm diameter each *(arrowhead)*. A barium enema (Fig. 37.4), colonoscopy (Fig. 37.5c), colonic biopsies from the lesion in the cecum (Fig. 37.6b) were performed. Colonic biopsy samples grew *Mycobacterium tuberculosis* on culture. He made rapid clinical improvement with antituberculous treatment

bination with ileocecal involvement should strongly suggest the diagnosis of tuberculosis.

Barium enema and small bowel follow-through may show mucosal ulceration, strictures, deformed cone-shaped and retracted cecum, incompetent ileocecal valve, a wide gap between a thickened ileocecal valve and a narrowed ileum (Fleischner's sign), and a fibrotic terminal ileum that empties into a rigid contracted cecum (Stierlin's sign) (Fig. 37.4, *chapter X Fig 9*) (Suri et al. 1999; Balthazar et al. 1990; Ha et al. 1999). Small bowel enema (enteroclysis) has a special advantage in defining the site and number of small bowel strictures (*Chapter* ■ *Fig 5–7*)

Colonoscopy has been used in patients with colonic and ileocecal tuberculosis (Singh et al. 1998; Bhargava et al. 1992; Shah et al. 1992; Misra et al. 1999; Kalvaria et al. 1988). It has the advantage that targeted biopsies from endoscopic abnormalities can be taken for histology, culture, and molecular techniques (Kochhar et al. 1991; Pulimood et al. 1999; Jost et al. 1995; Anand et al. 1994; Kashima et al. 1995; Pfyffer et al. 1996; Yajko et al. 1995; Tevere et al. 1996; Rich et al. 1996; Simon et al. 1993; Schluger et al. 1994; Bradley et al. 1996; Wobeser et al. 1996; Carpentier et al. 1995; Vlaspolder et al. 1995; Shah et al. 1998). Colonoscopic examination in 50 patients of colonic tuberculosis revealed ileocecal disease in 16, ileocecal and contiguous ascending colon disease in 14, segmental colonic disease in 13, ileocecal disease and nonconfluent involvement of another part of the colon in 5, and pancolitis in two patients (Singh et al. 1996). The colonoscopic appearances include mucosal nodules and ulcers, stricture with nodules and ulcerations, and mucosal nodules with or without pseudopolypoid folds (Fig. 37.5). Nodules vary in size from 2 to 6 mm and have a pink surface. These are scattered and at places densely packed. Friability of mucosa over nodules is unremarkable. Ulcers may be from a few millimeters to 2 cm long and are superficial with sharply defined irregular margins. Ulcers are covered with slough, which is difficult to wash away. The surrounding mucosa is nodular and hyperemic and blends imperceptibly with normal mucosa. When the ileocecal valve is involved, it is edematous, deformed, patulous, and easily admits the endoscope into the diseased terminal ileum. With diffuse colonic involvement, mucosa from rectum to cecum is hyperemic and friable and shows areas of circumferential ulcerations of different sizes along the entire length of the colon. Biopsy samples should be taken from ulcer edge, ulcer base, nodules, and from adjacent normal mucosa.

Endoscopic mucosal biopsies from the colon and terminal ileum may show a mixture of pathologic changes and include (1) characteristic and diagnostic caseating granulomas in about 25% of patients, (2) noncaseating granulomas in about 35%, (3) ulceration with nonspecific granulation tissue and infiltration with polymorphs forming microabscesses in around 60%, (4) variable mucosal reparative changes in around



a **b**

Fig. 37.4a, b. Tuberculosis of colon**. a** Barium enema shows filling defect *(arrowhead)* and cone shaped deformity (*long arrow*) of the cecum. Appendix is normally filled**. b** Barium enema shows lack of distensibility and nodular defects of the hepatic flexure, transverse and splenic flexure *(arrowheads)*

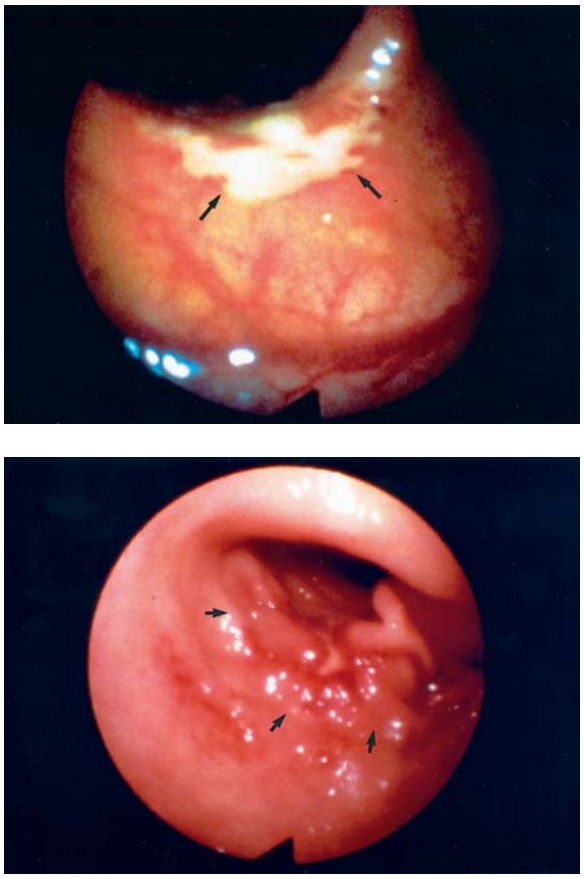


Fig. 37.5a, b. Tuberculosis of colon. Colonoscopic views in three patients. **a** A transversely placed ulcer in the descending colon *(arrows)*. **b** An infiltrative and nodular lesion in the transverse colon *(arrows)*. **c** Hypertrophic nodular mass in the cecum *(arrows)*

20%. Characteristic granulomas show caseous necrosis in the center, are often large, with marked variations in size, and usually tend to be confluent (Fig. 37.6). The granulomas seem to be enlarged by expansion of individual granulomas or by confluence of numerous satellite granulomas. This is in sharp contrast to sarcoid granulomas seen in Crohn's disease which are small in size, closely adjacent but discrete, and do not become confluent (Tandon and Prakash 1972).

Endoscopic mucosal biopsy rarely shows *M. tuberculosis* organisms on smear, and routine culture yields a growth of bacilli in only 6% to 40% of speci-

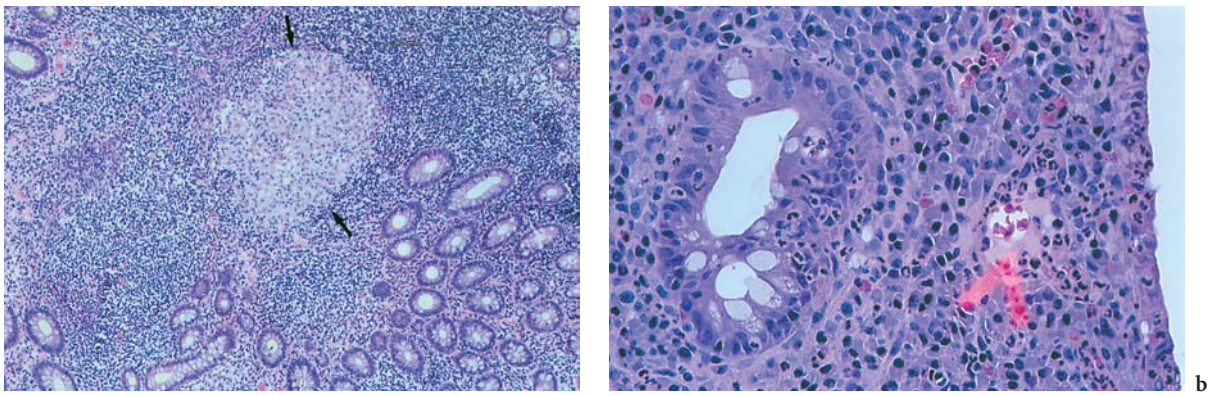


Fig. 37.6a, b. Tuberculosis of colon. **a** Histologic examination of colonic biopsy revealed dense lymphoplasmocytic infiltrate in lamina propria and a well-formed granuloma *(arrows)* consisting of epitheloid histiocytes and multinucleated giant cells. **b** Histologic examination of colonic biopsy showing moderate lymphoplasmocytic infiltrate in the lamina with infiltration and destruction of crypts *(arrow)*. No granulomas were seen

mens (Singh et al. 1996; Bhargava et al. 1992; Shah et al. 1992; Misra et al. 1999; Kalvaria et al. 1988). Recent technologic developments have introduced a number of improvements in the ability of clinical laboratories to cultivate and identify *Mycobacterium tuberculosis* complex more quickly and precisely than previously. These developments include more rapid detection of growth (Jost et al. 1995) and tests to identify RNA or DNA of *M. tuberculosis* complex directly in clinical samples (Anand et al. 1994; Kashima et al. 1995; Pfyffer et al. 1996; Yajko et al. 1995; Tevere et al. 1996; Rich et al. 1996; Simon et al. 1993; Schluger et al. 1994; Bradley et al. 1996; Wobeser et al. 1996; Carpentier et al. 1995; Vlaspolder et al. 1995; Shah et al. 1998). Exploitation of such tools for intestinal tuberculosis will make the diagnosis easier and more frequent.

37.3 Tuberculous Peritonitis

Pathogenesis (Marshall 1993; Singh et al. 1969). Peritoneal seeding by tubercle bacilli causes granulomas, which appear as multiple, whitish miliary nodules (<5 mm) scattered over the visceral and parietal peritoneum. In addition, the peritoneal lining along with the omentum and mesentery is thickened and adhesions develop with abdominal organs. A majority (>95%) of patients develop exudative free or loculated ascites; however, a small group of patients may have a more advanced dry fibroadhesive (plastic) or purulent form of disease. Plastic peritonitis causes adhesions and matting of bowel loops, mass formation due to matting of bowel loops, adenopathy, mesenteric and omental thickening (omental cake). Purulent peritonitis is usually secondary to tuberculous salpingitis and causes abscess formation due breakdown of caseous lesions in lymph nodes, mesentery, or omentum. These abscesses are present within matted bowel loops and thickened omentum and mesentery. Fistulae, both cutaneous and enteric, are common when such abscesses rupture either through the skin or into the bowel.

Clinical Manifestations (Marshall 1993; Singh et al. 1969; Manohar et al. 1990). Tuberculous peritonitis in its ascitic form presents insidiously with progressive abdominal distension. Diffuse abdominal pain (65%), fever (71%), and weight loss (38%) are seen in a variable percentage of patients. Clinical examination reveals shifting dullness, abdominal tenderness, and transverse solid epigastric intra-abdominal mass. The last is caused by rolled-up, thickened omentum infiltrated with tubercles. The encysted form of the disease produces a localized cystic mass usually in the central or lower abdomen, resembling a mesenteric cyst in children and ovarian cyst in females. Plastic peritonitis produces matted small bowel loops with thickening of, and adhesions with, omentum and mesentery. Patients often present with recurrent attacks of subacute intestinal obstruction. Acute intestinal obstruction may sometime supervene. Dilated bowel loops produce bacterial overgrowth and cause steatorrhea and wasting. Abdominal examination reveals single or multiple bowel masses which are resonant to percussion (thickened and matted bowel loops). Solid mass may be caused by thickened mesentery. Patients with purulent peritonitis are very sick, wasted, and in moribund clinical status. Abdomen examination reveals tenderness, guarding, multiple bowel masses, and usually a fecal fistula commonly near the umbilicus.

Patients with tuberculous peritonitis with cirrhosis of the liver present with similar clinical features to those without liver disease. However, patients with liver disease are younger (42±8 years vs 54±15 years, $p<0.01$) and have a higher maximum-recorded temperature (102±107 vs 100.5±1.3, $p<0.01$). In addition, clinical examination reveals hepatomegaly (48%) and splenomegaly (20%) due to underlying liver disease and portal hypertension (Aguado et al. 1990; Shakil et al. 1996).

Tuberculous peritonitis in patients with long-term or continuous ambulatory peritoneal dialysis present with fever, abdominal pain, and cloudy dialysate. Peritoneal fluid has predominance of polymorphonuclear cells as against lymphocytic predominant cells in tuberculous peritonitis associated with other conditions. Diagnosis is made at culture of the fluid, which grows tubercle bacilli in two thirds of such patients (Holley and Piraino 1990; Cheng et al. 1989; Lui et al. 1996; Lam et al. 2000; Talwani and Horvath 2000).

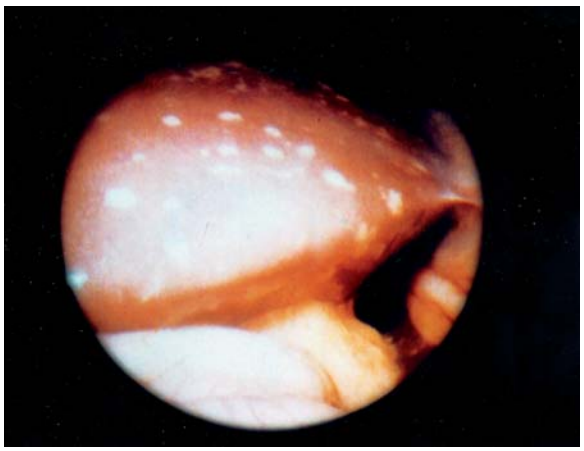
Diagnosis. Diagnosis of tuberculous peritonitis is mainly focused on the differential diagnosis of ascites and a well-established algorithm has been developed in clinical practice to do so (Table) (Runyon et al. 1992). The index of suspicion of tuberculous peritonitis should be high in following circumstances:

a. Residence in developing countries or immigration to a Western country from a developing country
b. Recent exposure to open tuberculosis
c. Underlying cirrhosis
d. Patients on long-term or continuous ambulatory peritoneal dialysis
e. Immunosuppressed patients, especially AIDS, and patients with liver or renal transplants

The value of a chest X-ray, PPD, and flat abdominal films has been discussed (Fig. 37.7). Abdominal imaging, especially CT scan, is useful for an initial investigation to give a comprehensive view of the abdominal organs. Ascitic fluid analysis gives an important lead to the possibility of infectious etiology. Laparoscopy and peritoneal biopsy is the investigation of choice to confirm the diagnosis of tuberculosis.

CT findings include changes in the peritoneal lining and cavity, mesentery, and omentum (Suri et al. 1999). Peritoneal lining shows smooth uniform thickening. Nodular implants with irregular thickening of the peritoneum are unusual and more often suggest peritoneal carcinomatosis (Fig. 37.8, *chapter X Fig. 19a, b*). Peritoneal fluid may be free or loculated and shows high-density signals (25–45 HU), possibly explained by high protein and cellular contents of the fluid. However, tuberculous ascites may also be near water density, perhaps reflecting an earlier transudative stage of immune reaction. Mesenteric infiltration can range from mild involvement in the form of linear soft tissue strands, thickened and crowded vascular bundles, a "satellite" appearance, and subtle increase in mesenteric fat density, to more extensive involvement resulting in diffuse infiltration with soft tissue density masses involving the leaves of mesentery surrounding the adjacent bowel loops. Omentum infiltration may cause thickening, smudged appearance, or omental "cake " formation. Retroperitoneal and mesenteric nodes may be enlarged and caseate to form large mesenteric abscesses (Fig. 37.9).

Ascitic fluid may be collected from either flank or centrally below the umbilicus with a blind peritoneal needle puncture and aspiration (Runyon 1986). In patients with minimal fluid collection or those with thick abdominal wall due to obesity, ultrasound-guided fluid collection may be done (Goldberg et al. 1970). Ascitic fluid examination should include gross inspection, biochemical tests, cytology, and smear and culture for tuberculosis. Fluid for a cell count should be sent to the laboratory in an anticoagulant tube (i.e., containing heparin ethylenediaminetetraacetic acid) to prevent clotting (Hoefs 1990). Before the 1980s, the ascitic fluid total protein concentration



a

b

Fig. 37.7a, b. Tuberculous peritonitis. A 50-year-old woman presenting with low-grade fever, weight loss, diffuse abdominal pain, and abdominal distension of 6 months duration. Clinical examination revealed abdominal tenderness and free fluid in the peritoneum. ESR was 60 mm and PPD skin test was 25 mm. X-ray chest revealed right apical infiltration and scarring. Ascitic fluid analysis revealed low-gradient lymphocytic exudate. **a** Laparoscopic examination revealed adhesions, peritoneal exudates, and multiple small (3 to 5 mm), whitish, elevated lesions on the visceral and parietal peritoneal surface. In this photograph multiple such lesions are shown on the liver surface. The results of a peritoneal biopsy from this patient are shown in Fig 37.10 **b** Plain X-ray of abdomen showing plaque-like calcification in the right and left upper quadrant (peritoneum – *thick arrow*), nodular calcification in the abdomen (lymph nodes – *arrowheads*), and incidental atherosclerotic linear calcification along the aortic wall (*arrow*).

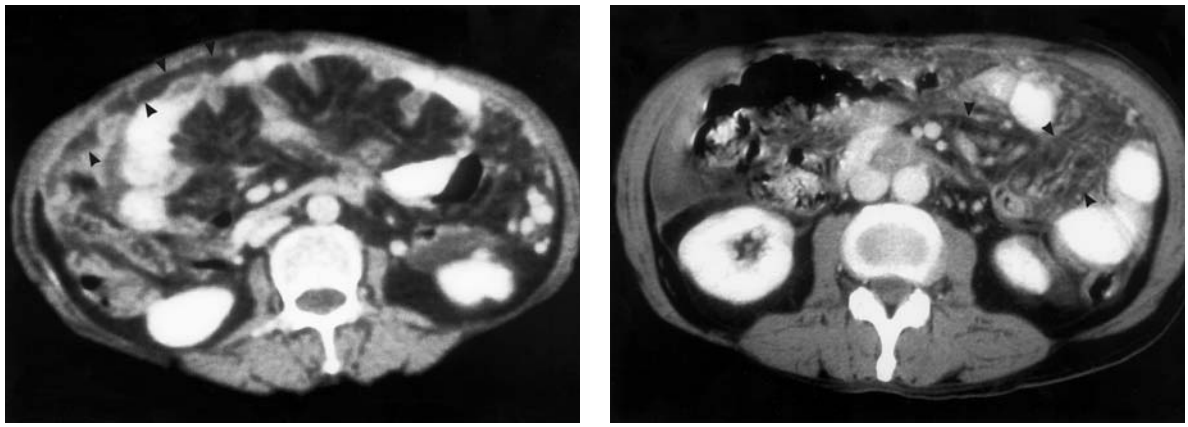


Fig. 37.8a, b. Tuberculous peritonitis. Computed tomography (CT) scans of two patients with documented tuberculous peritonitis. **a** Contrast-enhanced CT of abdomen shows thickening and fat infiltration of the omentum (omental plaque–-*arrowheads*). **b** Contrast-enhanced CT of abdomen showing irregularity and fatty infiltration of the mesentery *(arrowheads)*

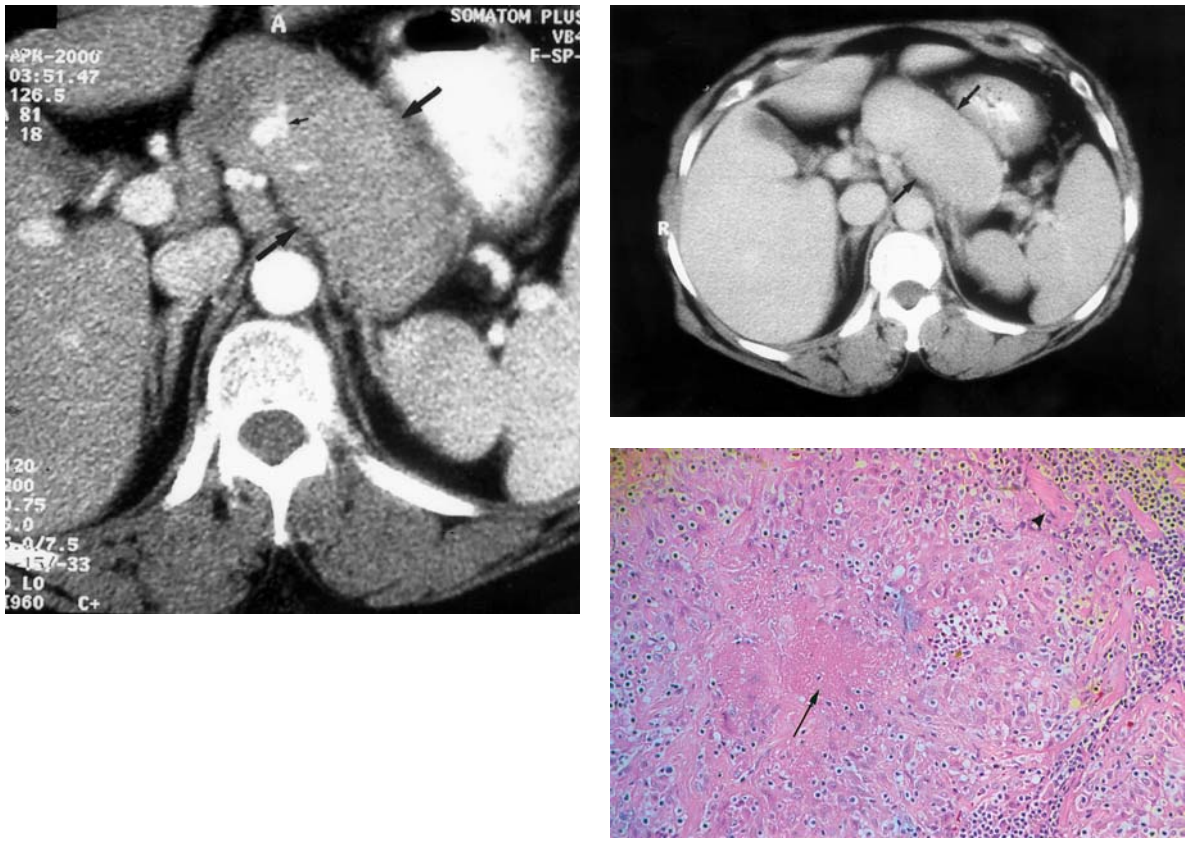


Fig. 37.9a–c. Tuberculous retroperitoneal mass. A 30-year-old woman presented with fever and night sweats of 3 months duration. Clinical examination was unremarkable. Plain X-ray of chest was normal. PPD skin test was 15 mm. Contrast-enhanced spiral CT of abdomen (**a and b**) showed 9×5 cm mass *(long arrows)* behind the stomach and displacing it anteriorly. **a** Arterial phase revealed celiac artery *(thin arrow)* within the mass, which was not involved by the lesion. **b** Late venous phase revealed minimal contrast uptake by the lesion *(arrows)*. **c** Histologic examination of the resected specimen revealed extensive necrotizing granulomatous lesion *(arrow)* with giant cells *(arrowhead)*

was used to classify ascites into exudate (>25 g/l) and transudate (<25 g/l). This classification does categorize ascites into various etiologic groups with a high degree of precision. Attempts at using combinations of lactic dehydrogenase (LDH) and serum-ascitic fluid ratio of LDH and protein have not been shown to improve accuracy of classifying ascitic fluid into exudate and transudate. The serum-ascites albumin gradient (SAAG) has proven in multiple studies to categorize ascites better than total protein concentration and better than other parameters (Runyon et al. 1992; Mauer and Manzione 1988). An SAAG of 11 g/l or more is classified as high gradient ascites, and an SAAG of less than 11 g/l is classified as low gradient ascites (Table). If the SAAG is high, the patient has portal hypertension as the cause of ascites, with 97% accuracy. If the SAAG is low, portal hypertension can be excluded as the cause of portal hypertension, with 97% accuracy. The accuracy of this test is not influenced by ascitic fluid infection, diuretic therapy, therapeutic paracentesis, albumin infusion, and etiology of liver disease.

Tuberculous ascitic fluid is usually opalescent due to high protein content and cell count (Marshall 1993; Holley and Piraino 1990; Singh et al. 1969; Manohar et al. 1990; Runyon et al. 1992). However fluids with a cell count of less than 1,000/cm^3 (1.0×10^9/l) may be almost clear. Fluids with counts of over 50,000/cm^3 (50×10^9/l) look purulent. Fluid may be sanguineous (RBC>10,000/mm^3) or frankly hemorrhagic (RBC>20,000/mm^3). Bloody ascitic fluid due to underlying disease should be differentiated from traumatic tap. The latter is only streaked with blood and frequently clots. In contrast, nontraumatic blood-tinged ascitic fluid is homogeneous and does not clot. Tuberculous ascitic fluid is uniformly of low gradient variety with a SAAG of less than 11 g/l and has a high cell count (150 to 4,000/mm^3) with lymphocytic predominance. Tuberculous fluid in patients with chronic peritoneal dialysis is typically neurocytic rather than lymphocytic.

Ascitic fluid adenosine deaminase is an enzyme involved in the catabolism of purine bases (conversion of adenosine to inosine) (Marinez-Vazques et al. 1986; Pettersson et al. 1984; Hillebrand et al. 1996). Levels of ascitic adenosine deaminase are increased in tuberculous peritonitis as a result of stimulation of T lymphocytes in response to cell-mediated immunity to mycobacterial antigens. A number of studies have shown that at a cut-off of >33 U/l, the sensitivity and specificity in tuberculous ascites are about 100% and 95%, respectively. A cut-off of >50 U/l may even be preferable because sensitivity remains excellent and false positives are almost eliminated. Ascitic adenosine deaminase has been proposed as a useful test in detecting peritoneal tuberculosis. However, in the United States, where more than half of patients with tuberculous peritonitis have underlying cirrhosis, ascitic adenosine deaminase has been found to be too insensitive to be helpful.

Examination of an acid-fast, stained smear of ascites will identify the organism in less than 3% of cases. The chances of culturing *M. tuberculosis* from the ascitic fluid are less than 20%. Culturing of ascitic fluid concentrated by centrifugation may increase the yield of culture. Culture reports are available by 4 to 8 weeks, which limits their diagnostic usefulness (Runyon et al. 1992).

Laparoscopy with directed biopsies is an excellent study for diagnosis of tuberculous peritonitis and should be done in all patients with low-gradient ascites, lymphocytic ascites, and in those with high risk or high index of suspicion of tuberculosis (Singh et al. 1969; Bhargara et al. 1992; Geake et al. 1981).

The laparoscopic appearances include:

a. Thickened peritoneum with loss of usual shiny luster, miliary yellowish tubercles of uniform size (about 4–5 mm) diffusely distributed over parietal peritoneum and loops of the bowel, multiple adhesions between organs and peritoneum: this pattern is seen in around 66% of patients.
b. Thickened parietal peritoneum with loss of luster, multiple adhesions between liver, peritoneum, and loops of the bowel: this pattern is seen in around 21%of patients.
c. Fibroadhesive pattern with marked thickening of parietal peritoneum, peritoneum may show yellowish nodules and cheesy material, thick adhesions may fix the viscera to anterior abdominal wall, sometimes it may not be possible to enter the peritoneal cavity: this pattern is seen in 13% of patients.

Laparoscopic biopsies from abnormal-appearing lesions detect caseating granulomas in 85–90% of patients (Fig. 37.10). Mycobacterium can be cultured in 40% of patients. Laparoscopy in patients with peritoneal tuberculosis appears to be relatively safe; complications occurred in around 3% of patients, including bowel perforation, intraperitoneal bleeding, and subcutaneous hematoma.

Blind peritoneal biopsies in patients with free ascites can be performed to obtain tissue for histology and culture. The procedure is reasonably safe and incidence of complications is low. The yield for positive diagnosis is lower than with laparoscopic-targeted biopsies. It is recommended in centers where laparoscopy is not

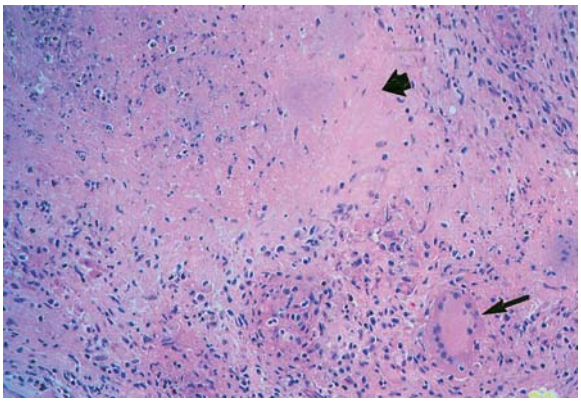


Fig. 37.10. Tuberculous peritonitis. Peritoneal biopsy showing extensive necrosis *(thick arrow)* with giant cells *(long arrow)*

available or in patients who refuse for laparoscopy. Minilaparotomy with peritoneal biopsies is recommended for patients with extensive peritoneal adhesions and for those patients for whom laparoscopy is nondiagnostic (Levine 1968; Shukla et al. 1982).

37.4 Tuberculosis of Mesenteric Lymph Nodes

Pathogenesis (Tandon and Prakash 1972; Marshall 1993). Tuberculosis of the mesenteric lymph nodes is considerably less common than intestinal or peritoneal involvement. Tubercle bacilli reach the nodes by way of Peyer's patches. Single or multiple lymph nodes along the mesentery may be involved. Lymph nodes are rounded or oval and readily mat together and calcify. Breakdown may occur giving rise to tuberculous pus in the mesentery. The bowel loop may become adherent, or disease may spread to the bowel wall or pancreas.

Clinical Manifestations (Mann et al. 1997). Tuberculosis of the mesenteric lymph nodes may present with systemic symptoms of the disease only (see above) without abdominal complaints. Sometimes nonspecific abdomen pain may accompany these symptoms. Abdomen lymph nodes may be palpable on deep palpation as firm, discrete, tender, bean-like masses most frequently to the right of and near the umbilicus. Sometimes reactivation of infection in the lymph nodes may cause pain and tenderness in the right iliac fossa resembling subacute appendicitis. Subacute intestinal obstruction may result from adhesions with a bowel loop or stricture as a result of involvement of the bowel wall by the caseous lymph node. A tuberculous mesenteric abscess gives rise to a palpable cystic mass. Enlarged lymph nodes in the ileocecal lymph nodes give rise to a palpable mass in the right iliac fossa.

Diagnosis (Suri et al. 1999; Batra et al. 2000). Abdominal imaging (ultrasound and CT scan) is the investigation of choice for patients with tuberculosis of mesenteric lymph nodes (Fig. 37.11, *Chapter X Fig 24*). In fact, imaging is often the tool which first points to this possibility when patients with vague abdominal symptoms are being investigated. Differential diagnosis includes other causes of lymph node enlargement including lymphoma, metastases, Whipple's disease, etc. Mesenteric and peripancreatic lymph nodes are commonly affected sites, reflecting the lymphatic drainage of commonly affected sites in the small bowel and liver. Isolated tuberculous retroperitoneal lymphadenopathy is uncommon and most patients also have affected lymph nodes at other sites. CT scan appearances of enlarged lymph nodes are as follows:

a. Enlarged nodes with hypodense centers and peripheral hyperdense rims. This is the commonest appearance and occurs in around 70% of patients.
b. Conglomerate mixed density nodal masses, most likely representing multiple confluent nodes due to perinodal spread of inflammation.
c. Enlarged nodes of homogeneous density, most often associated with low density nodes at other sites.

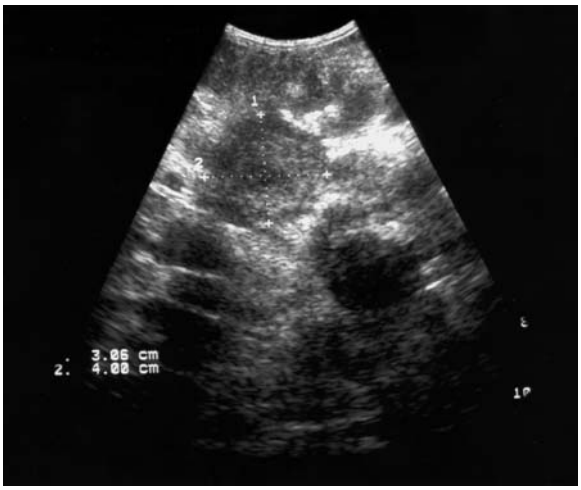


Fig. 37.11. Tuberculous lymphadenopathy. Ultrasound abdomen in A 30-year-old woman with abdominal pain and palpable abdominal masses showing multiple pre-aortic lymph nodes. Histology of the resected lymph nodes is shown in Fig. 37.12

d. Increased number (>3 in one CT section) of normal sized or mildly enlarged mesenteric nodes of homogeneous density, usually located along the mesenteric vessels or adjacent to the bowel loops.
e. Nodal calcification with characteristic distribution and appearance.

Whenever tuberculous lymphadenopathy is suspected, diagnosis is confirmed by ultrasound or CT-guided fine-needle aspiration biopsy and examining the aspirated material and/or core biopsy sample for histology, smear, and culture (Fig. 37.12). A biopsy can also be performed with a laparoscopy or minilaparotomy if radiologically guided biopsies cannot be done for reasons of access through a bowel loop.

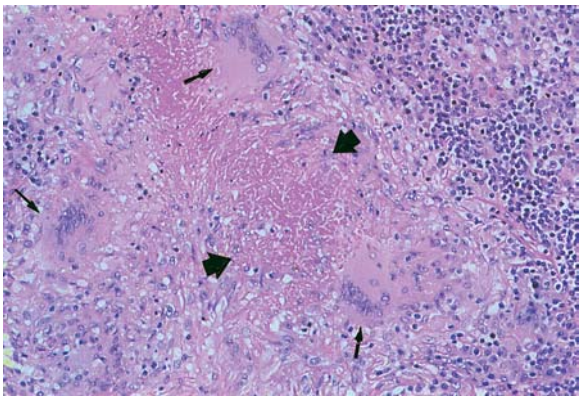


Fig. 37.12. Tuberculous lymphadenopathy. Histologic examination of the resected lymph node showing caseating granulomatous inflammation *(thick arrows)* with multiple giant cells *(thin arrows)* and surrounding lymphocytic infiltration

37.5 Tuberculosis of Solid Abdominal Organs

Hepatobiliary Tuberculosis. Hepatobiliary tuberculosis is seen in number of situations:

1. Incidental. Liver involvement is seen at autopsy in 25 to 50% of patients dying from active pulmonary tuberculosis. An autopsy study from West Africa found that 50% adults dying of AIDS have active tuberculosis and in 85% of them the liver is involved (Lucas 1994).
2. Miliary form. This occurs due to hematogenous spread of the tubercle bacilli. The liver is involved by multiple granulomas. Miliary tuberculosis presents with fever, night sweats, anorexia, weakness, and weight loss. Physical signs include hepatomegaly, splenomegaly, and lymphadenopathy. Elevation of serum alkaline phosphatase and other abnormal values in liver function tests are detected in patients with severe hepatic involvement. Liver biopsy revealed granulomas in a high percentage of patients and usually gives a clue to diagnosis (Raviglione and O'Brien 2001).
3. Granulomatous hepatitis. Patients present with unexplained fever, jaundice, hepatomegaly, elevated alkaline phosphatase, and abnormality of other liver function tests. Imaging of the liver may be normal or reveal nonspecific abnormalities. Laparoscopy is useful and shows cheesy, white, irregular nodules on the liver surface. Biopsy from such lesions reveals caseating granulomas [88]. Granulomatous hepatitis with multiple granulomas in the liver may also be seen following vaccination with bacille Calmette-Guérin, especially in persons with impaired immune response (Campos et al. 1996).
4. Nodular disease. In this entity, single or multiple focal masses develop in the liver and are seen as low-density nonenhancing lesions with or without peripheral rim enhancement. Such appearances need to be differentiated from lymphoma, fungal infection, and metastasis. Diagnosis is confirmed by image-guided fine-needle aspiration biopsy of the lesion (Herman et al. 1995; Achem et al. 1992; Buxi et al. 1992).
5. Tuberculous liver abscess. Tuberculous abscesses in the liver are extremely rare. The clinical picture and imaging resemble those of a pyogenic or amebic liver abscess. Culture of the aspirated material confirms the diagnosis by growth of tubercle bacilli (Rahmatulla et al. 2001).
6. Tubular disease. These patients present with obstructive jaundice due to involvement of the bile ducts. Bile ducts may be involved by an enlarged tuberculous lymph node compressing the bile duct or diffuse involvement of the intrahepatic ducts by tubercle bacilli. ERCP reveals multiple intrahepatic biliary strictures, areas of dilatation, beading and ectasia, resembling sclerosing cholangitis or cholangiocarcinoma. Biliary stricture may occur at hilar region or distal common bile duct with dilatation of the intrahepatic ducts (Alvarez 1998; Hickey et al. 1999).

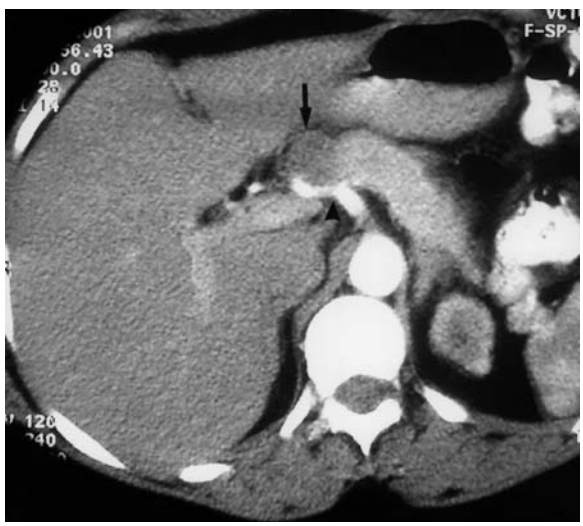
Splenic Tuberculosis. Tuberculosis of the spleen presents with fever, night sweats, asthenia, and loss of weight. The spleen is enlarged and is clinically palpable. Portal hypertension may ensue. Tuberculous splenic abscess is rare and presents as splenomegaly with a heterogeneous mass on ultrasound or CT. Splenic puncture will yield cold abscess and culture grows the organisms (Mann et al. 1997).

Pancreatic Tuberculosis. Pancreatic tuberculosis presents with a wide spectrum of symptoms such as abdominal pain, weight loss, fever, and obstructive jaundice. Abdominal ultrasound or CT detects pancreatic masses closely mimicking pancreatic carcinoma (Fig. 37.13). Diagnosis is only revealed with a fine-needle aspiration biopsy and culture of the aspirated material(Harland and Varkey 1992).

37.6 Tuberculosis of Other Gastrointestinal Sites

Esophageal, gastric, duodenal, and isolated appendicular tuberculosis are rare. Anal tuberculosis is rare in the West; however, it comprises 16% of the cases of fistulae-in-ano in developing countries (Marshall 1993).

Esophageal tuberculosis usually results from extension of the disease from mediastinal lymph nodes or spread from a pulmonary focus. Rarely, disease may occur without a primary contagious focus of disease. Esophagus reveals ulceration, nodularity, strictures, sinus-track formation, and fistulae with trachea or bronchus. Esophageal tuberculosis presents with dysphagia, odynophagia, choking, and aspiration due to tracheoesophageal or bronchoesophageal fistula and upper gastrointestinal bleeding. Bleeding from esophageal infiltration and ulceration is usually of no major consequence; however, massive bleed from aortoesophageal fistula complicating tuberculosis has been reported. Chest X-ray and CT scan of the chest are helpful in identifying active pulmonary lesion and mediastinal masses. Barium-swallow findings include ulcerations, stricture, pseudotumor masses, fistulae, sinuses, and traction diverticula. Upper gastrointestinal endoscopy with biopsy is the diagnostic procedure of choice and



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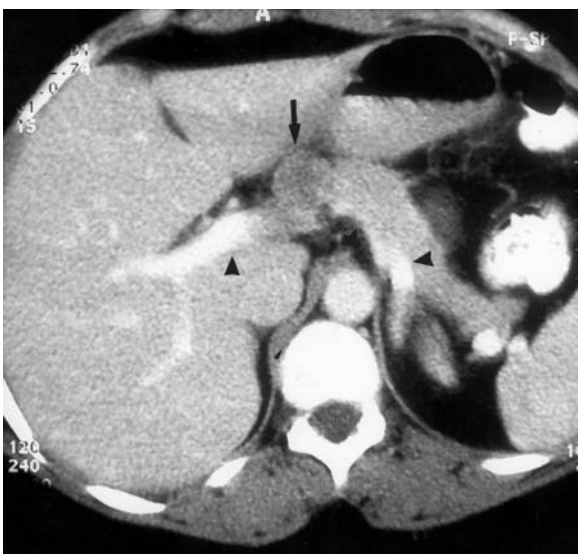

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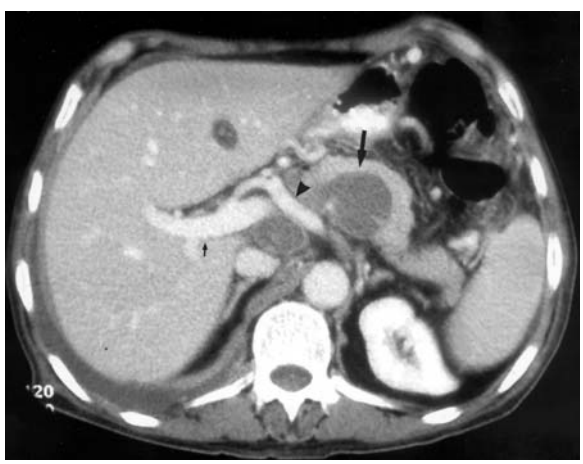

c

Fig. 37.13a–c. Pancreatic tuberculosis. Contrast-enhanced spiral computed tomography of abdomen (**a and b**) shows a hypodense mass *(long arrow)* in the head of pancreas. Arterial phase (**a**) revealed displacement of the hepatic artery *(arrowhead)*, and portal venous phase (**b**) revealed displacement of the portal vein *(arrowheads)*. **c** Spiral computed tomography of the abdomen in another patient revealed a well-defined hypodense mass *(long arrow)* in the pancreas. Hepatic artery *(arrowhead)* and portal vein *(small arrow)* are well defined without displacement and involvement

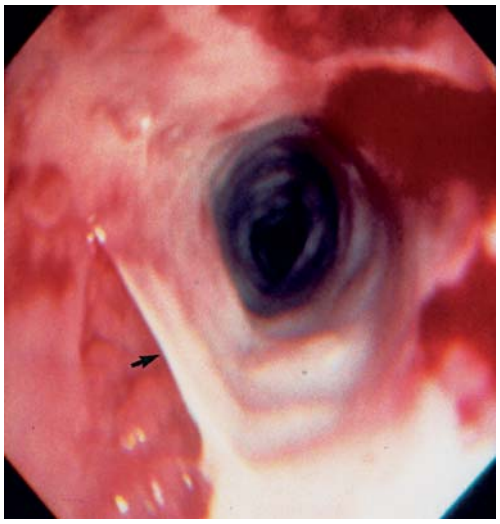

Fig. 37.14. Esophageal tuberculosis. Endoscopic view of esophagus shows ulceration, narrowing, and whitish exudates and pseudomembrane (arrow)

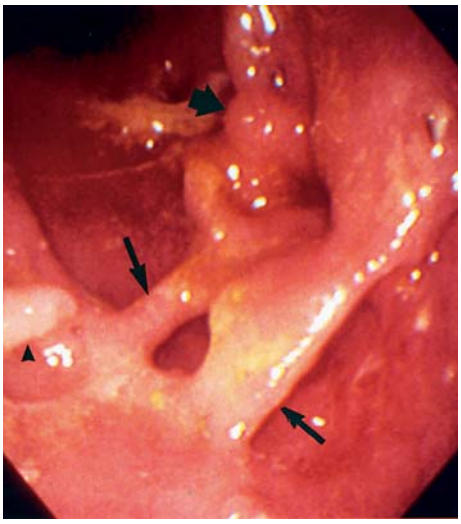

Fig. 37.15. Gastric tuberculosis. Endoscopic view of stomach showing ulceration *(arrowhead)*, nodularity *(thick arrow)*, and bridging mucosal lesions *(long arrows)*

usually reveals the etiologic nature of the esophageal disease (Fig. 37.14). In patients with mediastinal lymphadenopathy, endoscopic ultrasound has made a major advance in identifying the nodes, and biopsies can be taken from these lesions for histology and culture under endoscopic ultrasound guidance (Tassios et al. 1995; Eng and Sabanathan 1991; Sutton 1990).

Gastric tuberculosis usually occurs in the absence of pulmonary disease. This has been attributed to the presence of acid and paucity of lymphoid tissue in the stomach. Disease causes ulceration, nodularity of the mucosa, a tumor-like mass, and extensive submucosal infiltration and fibrosis causing linitis plastica. The antrum is the most common site of involvement. Gastric tuberculosis presents with nonspecific symptoms including abdominal pain, nausea, vomiting, and gastrointestinal bleeding. Such symptoms are usually confused with peptic ulcer or gastric neoplasm. Fever, night sweats, and weight loss may point to the possibility of tuberculosis. Barium meal and upper gastrointestinal endoscopy reveal ulceration, gastric outlet obstruction, nodular masses, and rigid nondistended stomach suggestive of linitis plastica (Fig. 37.15). Diagnosis is usually confirmed at histologic examination of the resected stomach (Lin et al. 1999; Rathnaraj et al. 1997; Quantrill et al. 1996; Goh et al. 1994; Raskin 1976).

Duodenal tuberculosis commonly occurs secondary to extraintestinal lymph node involvement and causes segmental narrowing of the lumen. However ulceration, nodularity, and masses may develop due to mucosal disease. Duodenal tuberculosis usually causes duodenal stricture and presents as abdominal pain, vomiting, and gastric stasis. Barium meal examination (Fig. 37.16, *chapter* ■ *Fig 1–3*) and upper gastrointestinal endoscopy define the type of involvement of the duodenum. Biopsies are usually not helpful and show nonspecific changes. Diagnosis is confirmed at histologic examination of resected diseased segment (Marshall 1993).

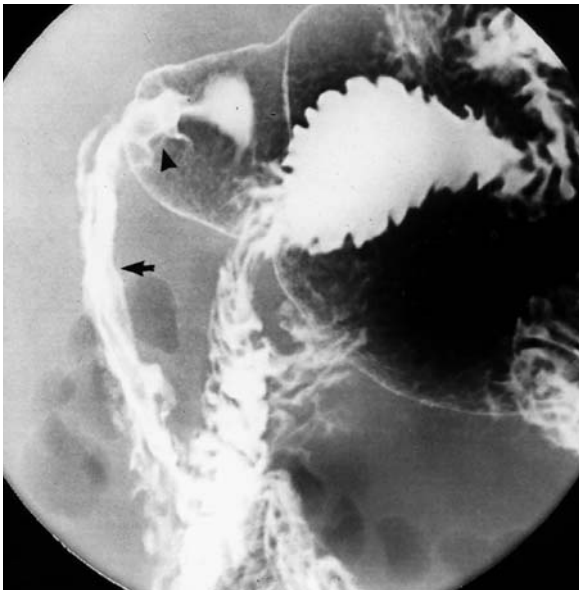

Fig. 37.16. Duodenal tuberculosis. Barium-meal examination of stomach and duodenum showing duodenal loop irregularity and narrowing *(arrow)* and an ulcer in the duodenal bulb *(arrowhead)*

Appendix involvement is common in patients with ileocecal tuberculosis. Isolated appendicular tuberculosis causes subacute inflammation. Isolated appendicular tuberculosis presents as nonspecific abdominal pain and right iliac fossa tenderness and simulates other clinical conditions involving organs in this region (Al-Hilaly et al. 1990).

Anal tuberculosis causes ulcers, fissures, fistulae, abscesses, and warty or hypertrophic growths. Active pulmonary tuberculosis is found in around 15% of such patients. Anal tuberculosis presents with a variety of appearances namely ulcers, fissures, fistulae, abscesses, and wart or hypertrophic growths (Fig. 37.17, *chapter* ■ *Fig 16, 17*). Crohn's disease causes similar appearances and in view of its higher occurrence in the West is the usual clinical diagnosis (Candela et al. 1999; Chung et al. 1997; Harland and Varkey 1992).

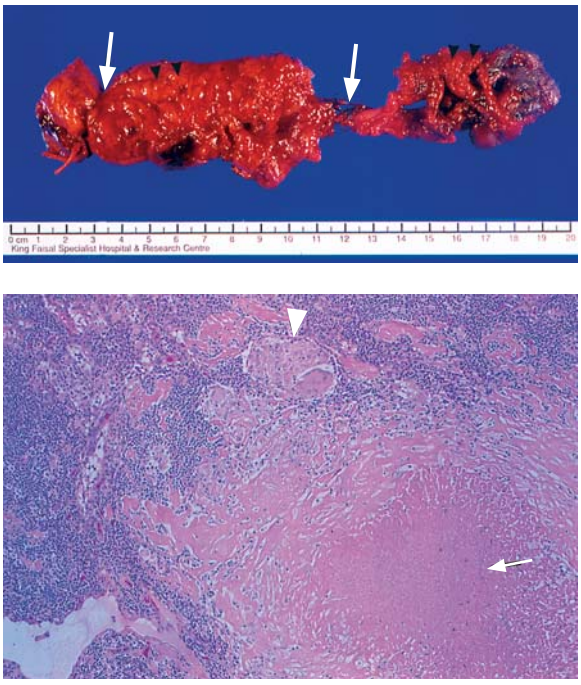

Fig. 37.17a, b. Anorectal tuberculosis. **a** Resected specimen of the rectum showing mucosal hypertrophy, nodularity *(arrowheads)*, and strictures *(arrows)*. **b** Histologic examination of the lymph node from the specimen revealed extensive caseating granuloma *(arrow)* with giant cells *(arrowhead)*

37.7 Treatment

Standard Drug Regimen. Patients with abdominal tuberculosis should receive a standard antituberculous drug regimen (Raviglione and O'Brien 2001). Therapy is highly successful and cure occurs in around 90% patients with tuberculosis of ileum and colon and over 95% patients with tuberculous peritonitis and tuberculosis of lymph nodes. Careful consideration needs to be given to selection of initial drugs for therapy, compliance issues, modification of drug regimen based upon drug susceptibility testing, and monitoring of the therapy and drug toxicity. These do not differ in any way from those of treating pulmonary tuberculosis. Short-course regimens are divided into an initial or bactericidal phase and a continuation or sterilizing phase. The initial phase consists of 2-month therapy with isoniazid, rifampicin, and pyrazinamide, followed by a 4-month therapy with isoniazid and rifampicin. If drug resistance is suspected on epidemiologic or other grounds, ethambutol (or streptomycin) should be included for the initial 2-month therapy or until the drug susceptibility tests become available. Treatment may be given daily throughout the course of therapy, or three times weekly throughout the therapy, or daily for the first 2 months followed by twice weekly for the next 4 months. Direct observed therapy (DOT) requires an intermittent dosage schedule and increases compliance. Provision of drugs in combined formulations is useful, as patients have to swallow only one tablet daily. It eradicates drug formulation errors, increases compliance and reduces chances of drug resistance. Pyridoxine should be added to the regimen given to persons at high risk of vitamin deficiency, namely alcoholics, malnourished persons, pregnant and lactating mothers, and patients with such conditions as chronic renal failure, diabetes, and HIV infection, because such patients are prone to neuropathy. A significant proportion of patients with abdominal tuberculosis are given therapy without positive cultures for tubercle bacilli. These patients need treatment with a standard regimen. Monitoring of response to treatment in abdominal tuberculosis is usually assessed by clinical parameters.

Course of Action When the Diagnosis Is Unclear. The diagnosis of tuberculosis may remain unclear despite the diagnostic efforts described above (Marshall 1993). This can occur in as many as 50% patients in developing countries, where diagnostic tools are not freely available and culture techniques have not been refined. Either of two possible actions can be taken in such cases: namely, therapeutic antituberculous trial or diagnostic exploratory laparotomy. In patients with clinical disease highly suggestive of

tuberculosis, a history of exposure to tuberculosis, a strong positive PPD, evidence of tuberculosis on chest X-ray, and residence or origin from developing countries, therapeutic antituberculous therapy is feasible. Rapid clinical response to medical therapy is seen. If the patient fails to respond within 2 weeks, a laparotomy is indicated. However many clinicians suggest prompt diagnostic laparotomy in absence of definite nonoperative diagnosis, since diseases like Crohn's disease, lymphoma, and malignancy can mimic tuberculosis in every possible way. Moreover the criteria for response are based on clinical criteria and fraught with errors.

Indications for Surgery. Surgery is indicated in a select group of patients with complications of abdominal tuberculosis (Bhansali 1977; Kapoor 1998; Marshall 1993; Shah et al. 1992). The most common indication for surgery is multiple and/or long strictures which are unlikely to respond to medical therapy. Rarely, strictures may become critical during antituberculous therapy. The surgical resection of strictures should be conservative. Strictureplasty is the standard treatment for single and especially multiple ileal strictures. An alternative is to do an endoscopic balloon dilatation of colonic or accessible terminal ileal strictures (Bhasin et al. 1998). Resection or bypass should be avoided as these may precipitate short bowel or blind loop syndrome. For hypertrophic ileocecal tuberculosis needing surgery, right hemicolectomy has been the treatment of choice in the past. Other reasons for surgical intervention include free perforation, confined perforation with abscess and fistula, massive bleeding and intra-abdominal cold abscesses.

Therapy in Patients with AIDS and Other Immunosuppressed Patients. Patients with immunosuppressed conditions including AIDS respond well to the standard 6-month regimen (Raviglione and O'Brien 2001; Small et al. 1991). Treatment may be prolonged to 9 months if the response is graded as suboptimal. Rifampicin shortens the half life of HIV protease inhibitors, indavir or nelfinavir, and therefore is contraindicated when antiviral therapy is being given concomitantly. In such situations, rifabutin (150 mg/day or 300 mg twice weekly) is given instead of rifampicin.

Therapy in Patients with Liver Disease. Patients with liver disease pose a special problem because of the hepatotoxicity of isoniazid, rifampicin, and pyrazinamide (Raviglione and O'Brien 2001). These drugs should be avoided and if absolutely essential should be used in reduced dosage under close supervision. Patients with severe hepatic dysfunction may be treated with ethambutol and streptomycin and if required with reduced doses of isoniazid and rifampicin under close monitoring for drug toxicity. Pyrazinamide in patients with severe hepatic disease is contraindicated.

Adjunctive Glucocorticoid Therapy. Some clinicians administer glucocorticoids for 2 to 3 months along with antituberculous treatment on the assumption that this therapy will decrease fibrosis during healing. This may in turn reduce stricture formation in intestinal tuberculosis and adhesions in peritoneal tuberculosis. However, this has not been substantiated by any well-conducted therapeutic trial. In fact, large series of patients with intestinal tuberculosis have been treated without glucocorticoids and no strictures showed up in the follow-up. In other series, patients treated with or without adjunctive glucocorticoids did equally well (Dooley et al.).

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