

Abdominal tuberculosis in children Report of 10 cases

S. Boukthir¹, S. Mazigh Mrad¹, S. Ben Becher², F. Khaldi³, S. Barsaoui¹

(1) Service de Médecine Infantile C ; (2) Service PUC ; (3) Service de Médecine Infantile A, Hôpital d'Enfants, Tunis Jebbari, Tunisia.

Abstract

Background : Abdominal tuberculosis is a rare location of this infection with a lot of diagnostic difficulties. The aim of this study was to review our experience of pediatric abdominal tuberculosis with that of the literature data.

Patients and methods : A retrospective study was conducted over a 7- year period ; 10 cases of abdominal tuberculosis in children were reviewed (6 girls and 4 boys, mean age : 11 years, extremes 4-14). Eight patients enrolled in this study satisfied the following criteria : a positive culture for mycobacterium tuberculosis on samples of ascites fluid, sputum, urine, abscess puncture and/or caseating granulomas on histologic examination of biopsies obtained by endoscopy, percutaneous aspiration or needle biopsy or exploratory laparotomy. Two other patients (patients N° 1 & 5) had a favorable response within 10 weeks of antituberculous therapy.

Results : We observed 8 cases of peritoneal tuberculosis and 2 cases of intestinal tuberculosis. Extra-abdominal tuberculosis was found in 4 of those patients. Two patients had a contact with a tuberculosis positive individual. Nine children had BCG immunization.

The main clinical features were abdominal distension (6 cases) and abdominal pain (6 cases). Abdominal ultrasonography visualized mesenteric lymphadenopathies (6 cases), an abdominal mass (5 cases), free (1 case) and localized ascites (1 case). Barium enema and small bowel series showed small bowel stenosis (1 case) and ileal ulcerations (1 case).

Exploratory laparotomy, performed in 3 patients, showed whitish granulations and peritoneal abscesses with caseous necrosis on histology. Quadruple therapy with tuberculostatic agents was prescribed in all patients, associating isoniazid, rifampicin, pyrazinamide combined at the start of the treatment with streptomycin (7 cases) and ethambutol (3 cases). Short term outcome was favorable with no deaths. The long term outcome was complicated by persistent ascites (1 case) and the development of portal hypertension (1 case).

Conclusion : Abdominal tuberculosis remains a rare localization with a lot of diagnostic difficulties. (*Acta gastroenterol. belg.*, 2004, 67, 245-249).

Key words : abdominal tuberculosis, mycobacterium, child.

In 1975, tuberculosis incidence in Tunisia was 49 cases per 100 000 people. Currently, it is 23 cases per 100 000 people. Almost 98.9 per cent of children are vaccinated by BCG vaccine. Tunisian national health situation has improved by the application of vaccination, pasteurization of milk, increased standard of living, and finally provision of health care. In developed countries, a surge in the number of patients presenting with gastrointestinal tuberculosis is reported (1). It is, partly, due to the epidemic of acquired immunodeficiency syndrome (AIDS) and the influx of patients from endemic areas of tuberculosis (2).

Pulmonary tuberculosis is by far the most frequent localization in Tunisia : 71.1% in 1992 (3). Abdominal tuberculosis is a rare disease characterized by its polymorphic clinico-pathological features and diagnostic difficulties.

The aim of this study was to review our experience of pediatric abdominal tuberculosis with that of the paediatric literature data.

Patients and methods

We conducted this retrospective study over a 7-year period, between 1989 and 1996 in our unit which is a part of a general pediatric department specialized in pediatric gastroenterology.

Ten cases of abdominal tuberculosis in children were reviewed (6 girls and 4 boys, mean age : 11 yrs, extremes 4¹/₂-14). Eight patients enrolled in this study satisfied the following criteria : a positive culture for mycobacterium tuberculosis on samples of ascites fluid, sputum, urine, abscess puncture and/or caseating granulomas on histologic examination of biopsies obtained by endoscopy, percutaneous aspiration or needle biopsy or exploratory laparotomy. Two other patients (patients N° 1 & 5) had a favorable response within 10 weeks of antituberculous therapy.

The Mantoux tuberculin skin test uses 5 tuberculin units of purified protein derivative (PPD) which are injected intradermally. The test is considered positive if an induration > 10 mm is obtained in children without prior BCG vaccination or > 15 mm in children with prior BCG vaccination.

Clinical characteristics, laboratory, radiological data, treatment and outcomes for the 10 children with abdominal tuberculosis are summarized in table I. Table II summarizes the diagnostic criteria for the 10 enrolled children with abdominal tuberculosis.

Results

During the 7 years of the study, 34357 children were hospitalized in our department. The incidence of

Presented at the session of March 10, 2002.

Reprint request : Dr. Samir Boukthir, Service de Médecine Infantile C, Hôpital d'Enfants de Tunis, Bab Saadoun 1007 Tunis Jebbari, Tunisia. E-mail : samir.boukthir@rns.tn.

Table I. — Clinical characteristics, laboratory and radiological data, treatment and outcomes for the 10 children with abdominal tuberculosis

Case	1	2	3	4	5	6	7	8	9	10
Sex	Female	Female	Female	Male	Female	Female	Female	Male	Male	Female
Age (years)	10	14	11	13	12	13	8	4 1/2	14	9 1/2
Origin of contamination	Grand mother						Grand father			
Disease duration	1 year	1 month	15 months	2 1/2 years	1 month	9 months	2 months	10 days	46 months	9 months
Type of onset	Insidious	Insidious	Insidious	Insidious	Insidious	Insidious	Insidious	acute	Insidious	Insidious
Clinical data	Cervical lymphadenopathy splenomegaly	Weight loss, fever, mass of the hypogastrium, abdominal pain	Right iliac osteitis, tuberculosis adenitis treated during 9 months, arthralgia, abdominal pain	Chronic diarrhea, pallor, weight : -3SD, height : -3SD	Weight loss, fever, ascites, abdominal pain	headache, fever, abdominal mass	fever, pallor, periumbilical mass, choreiform movements, clavicular lymphadenopathy	Fever, weight loss, anorexia, Swelling of the right flank, abdominal pain	Abdominal pain	Ascites, weight loss, abdominal swelling, abdominal pain
Biology	ESR : 60/160 mm, Hb : 11 g/dL	ESR : 95/120 mm	ESR : 128/135 mm, Hb : 7.8 g/dL	ESR : 55/90 mm, Hb : 8.4 g/dL	ESR : 10/35 mm, Hb : 11.5 g/dL	ESR : 107 mm, Hb : 8.2 g/dL	ESR : 100/125 mm, Hb : 6.5 g/dL	ESR : 60/105 mm, Hb : 9g/dL	ESR : 50/80 mm, Hb : 13 g/dL	ESR : 28 mm, Hb : 11.6 g/dL
Bacteriology		M. tuberculosis	M. tuberculosis	M. tuberculosis						M. tuberculosis
– Abdominal US :	Splenomegaly multiple lymph nodes	Multiple lymph nodes	Splenomegaly, multiple mesenteric nodes, bilateral hydronephrosis		Hepatomegaly, splenomegaly, ascites ; multiple mesenteric nodes	Multiple nodes compressing inferior vena cava	Hypochogetic mass, multiple nodes	Abdominal and pelvic mass	Hepatomegaly, splenomegaly, multiple lymph nodes, portal hypertension	Localized ascites
– Barium enema / small bowel series :			Ileum stenosis	Irregular narrowing of the distal portion of ileum.	Internal capsula nodule					
– Fibroscopy/ coloscopy :			Stenosis and fistula of the 3 rd portion of duodenum	Stenosing tumoral process, bulging in cecum, polyp of the left colon covered with congestive mucosa						
– CT scan :					trepassing on left thalamus					
Diagnosis	Mesenteric lymph node tuberculosis	Peritoneal and mesenteric lymph node tuberculosis- Miliary tuberculosis	Intestinal, peritoneal, mesenteric lymph node tuberculosis, Miliary tuberculosis	Intestinal tuberculosis	Peritoneal tuberculosis	Mesenteric lymph node and peritoneal tuberculosis	Tuberculoma- Mesenteric lymph node and peritoneal tuberculosis	Peritoneal and mesenteric lymph node tuberculosis	Mesenteric lymph node tuberculosis	Peritoneal tuberculosis
PPD skin test	positive	negative	negative	negative	positive	positive	positive	positive	positive	negative
Outcome	favorable	favorable	favorable	favorable	favorable	Favourable	Favourable	Favourable	Thrombosis of the portal vena	Ascites relapse

Table II. — **Diagnostic criteria for the 10 enrolled children with abdominal tuberculosis**

	Observations
A positive culture for mycobacterium tuberculosis from :	
– ascites liquid	N° 3, 10
– sputum samples	N° 3, 4
– urine	N° 3
– abscess puncture	N° 3
Histologic examination of biopsy material obtained by :	
– needle biopsy of lymph node	N° 3, 6, 7
– exploratory laparotomy	N° 2, 8, 9
Favorable response to a trial of antituberculous therapy	N° 1, 5

abdominal tuberculosis was 2.91 cases per 10 000 hospitalizations. Abdominal tuberculosis represented 20% of all tuberculosis cases collected during this period.

The other tuberculosis infections were pulmonary tuberculosis and lymph node tuberculosis.

Six patients were country people. Data on the type of milk consumed were missing in the children's files. Two patients had a contact with a tuberculosis positive individual (grand parents). Nine children had BCG immunization. No one had AIDS.

Abdominal tuberculosis was primary in six children. Extra-abdominal tuberculosis was present in four patients : pulmonary tuberculosis in two patients, tuberculosis of the urinary tract in one case and tuberculous adenitis in another case.

Among our patients, there were 8 cases of peritoneal tuberculosis and two cases of small bowel tuberculosis (patients 3 and 4).

The main clinical features were abdominal distension (6 cases) and abdominal pain (6 cases).

Laboratory findings

Erythrocyte sedimentation rate (ESR) was accelerated in all cases with a median of 88 (60 - 128 mm). Eight patients had anemia ranging between 6.5 and 11.5 g/dL.

Three cases exhibited hypoalbuminemia (median : 2.55 g/dl, ranges : 2.1-2.7 g/dl), whereas hypergamma globulinemia was seen in 2 other cases. Ascites fluid was haematic or yellow and exudative in 2 cases with a median protein concentrations of 53 g/L (46 and 53 g/L). Adenosine deaminase activity was not measured in our series.

Bacteriological data

The PPD skin test was positive in 7 cases. Mycobacterium tuberculosis was detected and cultured in 4 patients : ascites liquid in 1, sputum samples in 1, urines in 1 and in the last one urines, sputum and abscess puncture culture were all positive. Mycobacterium tuberculosis was sensitive to all antituberculous antibiotics. No mycobacterium bovis was detected in our series.

Upper fibroscopy was performed in 3 patients, showing the following lesions ; stenosis and fistula of the 3rd portion of the duodenum in one case associated with peritoneal and intestinal tuberculosis (patient N° 3), atrophic gastritis in one case with intestinal tuberculosis (patient N° 4), and an external compression of duodenum in one case of tuberculous adenitis (patient N° 9).

Chest radiographs showed patchy alveolar infiltrates in 4 cases, interstitial infiltrate and pleural effusion in 1 patient and mediastinal lymphadenopathies in 2 cases. Urinary tract radiography visualized mesenteric calcifications in 1 patient (patient N° 7).

Abdominal CT scan, performed in 3 patients, visualized mesenteric lymphadenopathies in two cases (patients N° 2 and 7).

In patient 4, small bowel series showed an irregular narrowing of the distal portion of ileum making Crohn disease diagnosis highly suspected. Colonoscopy showed a narrowing tumoral process of caecum evoking carcinoma of the colon. Mycobacterium tuberculosis was later detected in a culture of sputum samples.

In patient 3, in whom diagnosis of generalized tuberculosis was suspected, colonoscopy with biopsies showed a normal colic mucosa.

Exploratory laparotomy was performed in 3 patients, because of unclear diagnosis in two patients (N° 2 and 9) and an acute surgical abdominal tenderness suggesting digestive perforation in patient N° 8. In these patients, whitish granulations and peritoneal abscesses were visualized and histology revealed caseating granulomas. No laparoscopy was carried out in this series.

Quadruple tuberculostatic treatment was prescribed in all patients based on the combination of Isoniazid (10-15 mg/kg/day), Rifampin (10-20 mg/kg/day), Pyrazinamide (20-40 mg/kg/day), combined at the start of the treatment with Streptomycin (20-40 mg/kg/day) in 7 cases and Ethambutol (15-25 mg/kg/day) in 3 cases. The median duration of treatment was 10.5 months, (range : 6 and 19 months). No one received corticoids (Table III).

Short term outcome was favorable in all cases with no deaths. No adverse effects of antituberculous chemotherapy were noted. An outcome follow up of a median of 13 months (1-34 months) was favorable in 8 cases. Ascites persisted after 1 month of chemotherapy in patient N° 10 who continued his treatment in Algeria. Patient N° 9 developed portal hypertension due to portal obstruction by enlarged mesenteric lymph nodes.

Discussion

Abdominal tuberculosis is rare in children. In our study, its incidence was 2.9 cases per 10 000 hospitalizations. Abdominal tuberculosis represented 20% of all tuberculosis cases collected during the study period. This might reflect an important recruitment bias. In Marrocco, peritoneal tuberculosis represents 76.3% of abdominal tuberculosis and 34% of all tuberculosis

Table III. — Therapeutic regimen for the 10 children with abdominal tuberculosis

Patient	Treatment	Duration
1	Iso-Rif-Pyr-Strep Iso-Rif-Pyr	2 months 6 months
2	Iso-Rif-Pyr-Eth Iso-Rif-Eth Iso-Rif	2 months 2 months 6 months
3	Iso-Rif-Pyr-Strep Iso-Rif-Pyr Iso-Rif	2 months 7 months 2 months
4	Iso-Rif-Pyr-Strep Iso-Rif-Pyr Iso-Rif	2 months 4 ½ months 2 months
5	Iso-Rif-Pyr-Strep Iso-Rif	2 months 9 months
6	Iso-Rif-Pyr-Strep Iso-Rif	2 months 6 months
7	Iso-Rif-Pyr-Strep Iso-Rif	2 months 7 months
8	Iso-Rif-Pyr-Strep Iso-Rif	2 months 17 months
9	Iso-Rif-Pyr-Strep Iso-Rif	2 months 11 months
10	Iso-Rif-Pyr-Eth Iso-Rif	2 months 6 months

Iso : Isoniazid
Rif : Rifampicin
Pyr : Pyrazinamide
Strep : Streptomycin
Eth : Ethambutol

cases in children (4). In developed countries, the number of extra-pulmonary tuberculosis in adults has increased by the late eighties (5,6).

Abdominal tuberculosis consists of 3 forms : peritoneal tuberculosis, intestinal tuberculosis and mesenteric lymph node tuberculosis, which are difficult to distinguish in children.

We collected 8 cases of peritoneal tuberculosis and 2 cases of intestinal tuberculosis. Veeragandham *et al.* (7) reported 26 cases of abdominal tuberculosis in children ; 13 cases of intestinal tuberculosis and 9 cases of peritoneal tuberculosis.

The pathophysiology of tuberculous enteritis has been attributed to 4 mechanisms ; 1) hematogenous spread from active pulmonary or miliary tuberculosis ; 2) swallowing of infected sputum in patients with active pulmonary tuberculosis ; 3) ingestion of contaminated milk or food and 4) contiguous spread from adjacent organs. After the tubercle bacillus enters the gastrointestinal tract, it crosses the mucosa to lodge in the submucosa. There, the presence of the bacillus induces inflammatory changes, including serosal and submucosal edema, cellular infiltration, 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 (8).

Abdominal tuberculosis could be difficult to diagnose. Symptoms are vague and signs are nonspecific. In our study, clinical manifestations were not specific, mimicking several diseases such as celiac disease, periodic disease and Hodgkin lymphoma.

Ileocecal tuberculosis was seen in two of our patients (N° 3 and 4, Table I) and a differential diagnosis including Crohn disease and colon carcinoma was made in one case (patient N°4, Table I). Amebiasis, yersinia infection, gastrointestinal histoplasmosis and periappendiceal abscess were other possibilities (9). Surgery is applied in these cases of uncertain diagnosis.

Our study was characterized by the long delay of confirming diagnosis, more than two months in 6 cases. Abdominal pain was the most frequent observed sign, seen in 6 patients followed by weight loss and fever. In the literature, colicky mid-abdominal and right lower quadrant pain which reflects intermittent partial bowel obstruction is the presenting complaint in 90-100% of patients (5,6,10). PPD is positive in 70 to 86% of cases (7,9,10), while about 48% of patients have abnormality of chest x-ray (7,11). ESR ranged from 25 to 105 mm/h (7).

Table IV summarize the frequency of signs and laboratory findings in our study and literature.

Determination of adenosine deaminase level in the ascites fluid, an enzyme involved in the catabolism of purine bases, is particularly useful in the diagnosis of tuberculosis peritonitis. Its level is increased as a result of stimulation of T-lymphocytes in response to cell-mediated immunity to mycobacterial antigens (12).

Polymerase chain reaction assay, performed on endoscopic biopsy specimens, is a useful technique in the diagnosis of gastrointestinal tuberculosis in the absence of tissue and culture positivity (13). Determination of ascites fluid levels of adenosine deaminase and polymerase chain reaction assay are however not available in Tunisia.

Radiographic findings of tuberculosis enteritis are nonspecific. Abdominal ultrasonography could help positive diagnosis when it shows mesenteric lymph nodes, ileocecal mass or ascites. Barium enema and small bowel series are useful, supporting intestinal tuberculosis diagnosis in 66 per cent of cases (1). The most common findings are a pipe stream colon and a cone shaped retracted caecum (1). A wide gap between thickened ileocaecal valve and narrowed ileum is another suggestive finding (1).

For patients with predominantly colonic symptoms, colonoscopy is helpful in establishing the diagnosis (14). Typical colonoscopic findings include deformation of ileocaecal valve of caecum, segmental nodular and ulcerative lesions, and finally, areas of strictures with nodules and ulcerations (15).

Laparoscopy with direct peritoneal biopsy is an excellent study for diagnosing tuberculosis peritonitis and should be considered in patients with unexplained ascites. Findings include multiple whitish "miliary" nodules scattered over the visceral and parietal

Table IV. — Frequency of signs and laboratory findings in our study and literature

	Our study	11, 14, 17	Veeragandham <i>et al.</i> (7)
Fever	40%	54-100%	53.8%
Ascites	20%	51-100%	34.6%
Abdominal pain	60%	36-93%	15.3%
Weight loss	70%	37-87%	61.1%
Abdominal swelling	60%	65-100%	23%
Anemia	80%	48-68%	
Positive PPD skin test	70%	55-100%	88.4%

peritoneum, adhesions between the peritoneum and organs (16). These findings were found in 3 of our patients during laparotomy. Laparoscopically guided peritoneal biopsies will detect caseating granulomas in about 72 to 95% of cases (6,11,16)).

The treatment of abdominal tuberculosis is primarily a medical one. Surgery is reserved for complications (obstruction, perforation, massive hemorrhage, abscess, and fistula). Conservative operations are generally recommended. Bowel resection should be reserved to circumferential or partially obstructing lesions (2).

A common effective treatment regimen is the daily triple anti-tuberculosis therapy (isoniazid, rifampicin, pyrazinamide) for two months followed by the bi anti-tuberculosis therapy daily or twice a week for 7 months (17). During the last few decades, recommendations for treatment of tuberculosis in children have focused on shorter, more intense regimens and on increased adherence to treatment. A 6 month short-course chemotherapy regimen has then been used with great success (18). This resulted in reduced cost and a minimization of the development of drug-resistant organisms.

The response to chemotherapy usually is excellent. Deaths in the beginning of treatment due to meningitis, small bowel obstruction or perforation have been reported (2). These severe complications could be prevented by an early diagnosis and treatment.

Long term outcome was complicated in two of our patients by persistent ascites and portal hypertension. In the literature, presentation of abdominal tuberculosis with portal hypertension is rare and reported cases are adult ones (19,20,21). Mechanisms invoked for such portal hypertension are compression of the portal vein by tuberculous lymph nodes at the hepatic hilum and disseminated tuberculosis involving the liver and spleen. In one reported case, after antitubercular therapy, features of portal hypertension disappeared as the nodes regressed (22).

Conclusion

Despite a large program of BCG vaccination, abdominal tuberculosis remains a non negligible percentage of tuberculosis in Tunisia. Abdominal pain, weight loss, and fever are the most indicative signs but are non specific.

References

- HORVATH K.D., WHELAN R.L. Intestinal tuberculosis : Return of an old disease. *Am. J. Gastroenterol.*, 1998, **93** (5) : 692-696.
- MC GEE G.S., LESTER W.F., POTTS J. *et al.* Gastrointestinal tuberculosis : Resurgence of an old pathogen. *Am. Surg.*, 1989, **55** : 16-9.
- Bulletin épidémiologique- Avril 1992, n° 4/92. Ministère de la Santé publique – DSSB.
- ABOULABDECH A., CLEMENT V., LE LRORIER B. *et al.* La tuberculose péritonéale de l'enfant. A propos de deux observations. *Revue de la littérature. Ann. Pédiatr.*, 1995, **42** : 41-46.
- ROSENGART T.K., COPPA G.F. Abdominal mycobacterial infections in immunocompromised patients. *Am. J. Surg.*, 1990, **159** : 125-30.
- LOUIE E., RICE L.B., HOLZMAN R.S. Tuberculosis in non-haitian patients with acquired immunodeficiency syndrome. *Chest*, 1986, **90** : 542-5.
- VEERAGANDHAM R.S.V., LYNCH F.P., CANTY T.G. *et al.* Abdominal tuberculosis in children. Review of 26 cases. *J. Pediatr. Surg.*, 1996, **31** : 170-176.
- HOWEL J.S., KNAPTON P.J. Ileo-caecal tuberculosis. *Gut*, 1964, **5** : 524-9.
- MARSHALL J.B. Tuberculosis of the gastrointestinal tract and peritoneum. *Am. J. Gastroenterol.*, 1993, **88** : 989-99.
- SCHULZE K., WARNER H.A., MURRAY O. Intestinal tuberculosis-experience at a Canadian teaching institute. *Am. J. Med.*, 1977, **63** : 735-45.
- MANOHAR A., SIMJEE A.E., HAFEEJEE A.A. *et al.* Symptoms and investigative findings in 145 patients with tuberculous peritonitis diagnosed by peritoneoscopy and biopsy over a five year period. *Gut*, 1990, **31** : 1130-2.
- DWIVEDI M., MISRA S.P., MISRA V. *et al.* Value of adenosine deaminase estimation in the diagnosis of tuberculous ascites. *Am. J. Gastroenterol.*, 1990, **85** : 13-5.
- ANAND S.S. Diagnosis of intestinal tuberculosis by polymerase chain reaction on endoscopic biopsy specimens. *Am. J. Gastroenterol.*, 1994, **89** : 2248-2249.
- BHARGAVA D.K., RANDON H.D., CHAWLA T.C. *et al.* Diagnosis of ileocecal and colonic tuberculosis by colonoscopy. *Gastrointest. Endosc.*, 1985, **31** : 68-70.
- TAM P.K., SAING H., LEE J.M. Colonoscopy in the diagnosis of abdominal tuberculosis in children. *Aust. Paediatr. J.*, 1986, **22** : 143-144.
- BHARGAVA D.K., SHRINIWAS, CHOPRA P. *et al.* Peritoneal tuberculosis : laparoscopic patterns and its diagnostic accuracy. *Am. J. Gastroenterol.*, 1992, **87** : 109-1.
- DINEEN P., HOMAN W.P., GRAFE W.R. Tuberculous peritonitis : 43 years' experience in diagnosis and treatment. *Ann. Surg.*, 1976, **184** : 717-22.
- BALASUBRAMANIAN R., NAGARAJAN M., BALAMBAL R. *et al.* Randomised controlled clinical trial of short course chemotherapy in abdominal tuberculosis : a five-year report. *Int. J. Tuberc. Lung Dis.*, 1997, **1** (1) : 44-51.
- LEE C.W., LEE Y.S., CHO G.Y., KIM J.Y., MIN Y.I. A case of extra-hepatic portal hypertension caused by periportal tuberculous lymphadenitis. *J. Korean Med. Sci.*, 1994, **9** (3) : 264-7.
- CAROLI-BOSC F.X., CONIO M., MAES B., CHEVALLIER P., HASTIER P., DEMONT J.P. Abdominal tuberculosis involving hepatic hilar lymph nodes. A cause of portal vein thrombosis and portal hypertension. *J. Clin. Gastroenterol.*, 1997, **25** (3) : 541-3.
- DIAB S., ABU NEMA T., ABU ZIDAN F. Portal hypertension complicating abdominal tuberculosis. Case report. *Acta Chir. Scand.*, 1990, **156** (6-7) : 495-7.
- DUTTA U., BHUTANI V., NAGI B., SINGH K. Reversible portal hypertension due to tuberculosis. *Indian J. Gastroenterol.*, 2000, **19** (3) : 136-7.