International Surgery Journal
Husain A et al. Int Surg J. 2018 May;5(5):1713-1719
http://www.ijsurgery.com
pISSN 2349-3305 | eISSN 2349-2902

DOI: http://dx.doi.org/10.18203/2349-2902.isj20181388

Original Research Article

Study of comparison of high resolution sonography and computed tomography in evaluation of abdominal tuberculosis among patients in Lucknow, Uttar Pradesh, India

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Received: 12 March 2018
Accepted: 19 March 2018

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ABSTRACT

Background: Despite individual evaluation of USG and CT scan in diagnosis of abdominal tuberculosis, there is limited literature available comparing the two methods. The present study was done to evaluate high resolution sonography and computed tomography in abdominal tuberculosis.
Methods: A total of 55 clinically suspected adult cases of abdominal tuberculosis were enrolled in this prospective observational study after taking informed consent in a tertiary hospital of Lucknow. SPSS software version 15.0 statistical analysis software was used for data analysis.
Results: The prevalence of abdominal tuberculosis among clinically suspected cases of abdominal tuberculosis was 77.8%. High resolution USG was 77.8% sensitive and 70% specific in diagnosis of abdominal tuberculosis. It provided a high efficacy in detection of intestinal tuberculosis but failed to provide a significant discriminatory difference between abdominal tuberculosis positive and negative cases for extra intestinal tuberculosis. Computed tomography was 35.3% sensitive and 80% specific in diagnosis of abdominal tuberculosis. It provided an excellent accuracy in diagnosing intestinal tuberculosis as well as extra-intestinal tuberculosis. The accuracy level of CT (90.9%) was found to be higher as compared to that of HR-USG (76.4%) and the difference was significant statistically too (p=0.039).
Conclusions: Computed tomography is useful in diagnosis of both intestinal and extra-intestinal abdominal tuberculosis and can be recommended for use in routine practice.

Keywords: Abdominal tuberculosis, Computed tomography, High resolution USG

INTRODUCTION

The diagnosis of abdominal tuberculosis is one of the key issues that needs to be addressed. Ultrasonography (USG) is beneficial in extra intestinal (peritoneal, lymph nodes) tuberculosis. The USG of abdomen may show a mass of matted loops of small bowel with thickened walls, rolled up or diseased omentum, and loculated ascites. Ultrasonography is also helpful in detecting tuberculosis.

The findings reported include dilated small bowel loops, bowel wall thickening showing a hypoechoic halo measuring> 5mm. Lastly ultrasound is also helpful for guiding procedures like ascitic fluid aspiration or fine

needly aspiration cytology or biopsy from the enlarged lymph nodes or hypertrophic lesions.[1]

With the evolution of computed tomography, it has become a useful tool in diagnosis of abdominal tuberculosis. Given its excellent imaging capabilities, abdominal CT scan has emerged as a better tool than ultrasound for detecting high density ascites, lymphadenophathy with caseation, bowel wall thickening and irregular soft tissue densities in the omental area.[2]

Abdominal lymphadenopathy is the commonest manifestation of tuberculosis on CT, contrast enhanced CT (CECT) is better than plain CT, shows four patterns of contrast enhancement, i.e. peripheral enhancement, non-homogenous enhancement, homogenous enhancement and homogenous non-enhancement. Though not pathognomic, the pattern of peripheral rim enhancement could be highly suggestive of tuberculosis. a similar pattern is seen in metastatic lymphadenopathy. The presence of calcification in the lymph nodes in the absence of a known primary tumor suggests tubercular lymphadenitis.

Tuberculosis involves predominantly the omental, mesenteric and upper para- aortic lymph nodes; while lower para-aortic lymph nodes are commonly involved in Hodgkin's and Non- Hodgkin's lymphoma. Thus, CT offers more differentiation and accuracy in identification of abdominal tuberculosis.

Despite individual evaluation of USG and CT scan in diagnosis of abdominal tuberculosis, there is limited literature available comparing the two methods. USG being much lower in terms of cost and availability as compared to CT, it is always desirable to evaluate whether it can offer the same or upto a reasonable level of accurate results as compared to CT in a low-resource setting like ours.

The present study is an attempt to evaluate and compare the two techniques in a tertiary care center. With this background the present study was carried out with an aim to compare the high-resolution sonography and CT in abdominal tuberculosis.

METHODS

The design of the study is based on a prospective observational study, which is 18 months long. The place of study is at the departments of Radiodiagnosis, medicine, surgery and pathology of Era's Lucknow medical college and hospital, Lucknow, Uttar Pradesh. All those cases who were clinically suspected of abdominal tuberculosis were considered under study population.

Sample size: sample size determination was done using the following formula:

$$N= [Za \sqrt{} 2p(1-p)+ 2\beta\sqrt{} p1 (1-p1)+p2(1-p2)]2/(p1-p2)2$$

Where, p1=0.307

P2=0.692 (based on pilot study)

P=(p1+p2)/2

Type 1 error (a) = 5% (probability of false positive)

Type 11 error (β) =20% (probability of false negative)

Power of study = 80%

Then sample size comes out to be:

N=50+10% data loss = 55

Inclusion criteria

- Adult individuals >18 years of age of either gender with clinically suspected abdominal tuberculosis, fulfilling one or more of the following conditions:
- Histological demonstration of caseating granuloma or acid-fast bacilli in the lesion or ascitic fluid.
- Growth of mycobacterium tuberculosis on culture of tissue or ascitic fluid.
- Satisfactory therapeutic response to chemotherapy in patients with clinical/laboratory/ radiological and operative evidence of abdominal tuberculosis.
- Combination of strong clinical suspicion and positive clinical/ laboratory/histological/radiological features at extra-abdominal sites.

Exclusion criteria

- Pregnant women, cases diagnosed for genitourinary tuberculosis and critically ill patients.

Approval for conducting the study was obtained from institutional ethical committee of Era's Lucknow medical college, Lucknow Informed consent was obtained from each patient enrolled in the study.

After enrollment in the study, demographic details and clinical history of the patient were noted in a proforma specially prepared for the purpose. The patients were then subjected to radiological evaluation. A separate probable diagnosis will be made for both HR sonography and CT evaluations.

Final diagnosis was done after correlating the radiological findings with clinical and laboratory evaluations. To validate the findings further clinical response to ATT therapy in cases diagnosed as positive for abdominal tuberculosis was noted at 3,6 and 9 months' interval. Final diagnosis was then correlated with HR sonography and CT diagnoses.

The statistical analysis was done using SPSS (statistical package for social sciences) version 15.0 statistical Analysis software.

RESULTS

A total of 45 (81.8%) cases were diagnosed as abdominal tuberculosis. a total of 10 (18.2%) cases were diagnosed as other illnesses 2 cases each of lymphoma and non-specific mesenteric lymphadenitis and 1 case each of abdominal cocoon, amoebiasis, appendicitis, chronic non-specific colitis, Ileal gangrene with mesenteric vessel and sarcoidosis respectively.

Table 1: Distribution of cases according to final diagnosis.

Final diagnosis	No. of cases	Percentage
Abdominal tuberculosis	45	81.8
Others	10	18.2
Abdominal cocoon	1	
Amoebiasis	1	
Appendicitis	1	
Chronic non-specific colitis	1	
Ileal gangrene with mesenteric vessel	1	
Lymphoma	2	
Non-specific mesenteric lymphadenitis	2	
Sarcoidosis	1	

Irrespective of the final diagnosis, majority of patients in both the groups were aged 21-40 years. Mean age of patients with abdominal tuberculosis was 28.4±10.6 years (range 15-55 years) while that of patients having other disorders was 32.1±6.1 (range 25-45) years. Statically, the difference between two groups was not significant (p=0.216). Majority of cases irrespective of final diagnosis were females. Statistically, no significant difference was observed between two groups (p=0.475).

Table 2: Age wise distribution of patients in two diagnostic groups (n=55).

Age group	Abdominal tuberculosis (n=45)		Other (n=55)	
	No.	%	No.	%
≤20 years	10	22.2	10	18.2
21-40 years	29	64.4	38	69.1
>40 years	6	13.3	7	12.7
Mean age ±SD	28.4±10.6(15-55)		32.1±6.1(25-45)	

X^2=3.067 (df=2) p=0.216

Table 3: Gender wise distribution of patients in two diagnostic groups (n=55).

Gender	Abdominal tuberculosis (n=45)		Others (n=10)	
	No.	%	No.	%
Male	17	37.8	22	40.0
Female	28	62.2	33	60.0

X^2=0.509 (df=1) p=0.475

On general USG assessment, a total of 32(71.1%) patients with abdominal tuberculosis had positive USG findings as compared to 5(50%) of those with other diagnosis. a significant difference between two groups was observed with respect to bowel wall thickening which was found to be 51.1% sensitive and 90% specific.

Table 4: Distribution of patients in two groups according to USG findings (n=55).

Feature	Abdominal tuberculosis (n=45)		Others (n=10)		Significance of difference	
	No.	%	No.	%	X^2	P
USG dilated bowel	23	51.1	4	40.0	0.404	0.525
Bowel wall thickening	23	51.1	1	10.0	5.622	0.018
Matting of small bowel	0	0	0	0	-	-
Terminal ileum thicking/ dilatation	15	33.3	0	0	4.582	0.032
Pulled up IC junction	13	28.9	0	0	3.783	0.052
Pulled up caecum	7	15.6	0	0	1.782	0.182
RIF mass	21	46.7	1	10.0	4.583	0.032
Presence of any of the above	32	71.1	5	50.0	1.656	0.198

Table 5: Diagnostic efficacy of USG based on finding of thickening and pleural effusion.

USG diagnosis	Final diagnosis		Total
	Tuberculosis	Others	
Tuberculosis	35	3	38
Others	10	7	17
Total	45	10	55

Among other USG findings terminal ileum thickening/dilatation and presence of RIF mass were also found to be having a significant difference between two groups. None of the other findings showed a significant difference between two groups. General USG assessment thus had a maximum sensitivity of 51.1% and specificity of 90%, thus showing that its sensitivity was close to flip-coin positivity (-50%).

Hence, we looked for more sensitivity criteria which was based on combined assessment of general and solid organ assessment. The sensitivity of USG was 77.8%, specificity was 70%, positive predictive value was 92.1% and negative predictive value was 41.2%. The overall diagnostic efficacy of USG for the evolved criteria was 76.4%.

Table 6: Distribution of patients in two groups according to CT findings (n=55).

Feature	Abdominal tuberculosis (n=45)		Others (n=10)		Significance of difference	
	No.	%	No.	%	X^2	P
Bowel wall thickening	29	64.4	1	10.0	9.782	0.002
Thickening shouldering	25	55.5	1	10.00	6.812	0.009
Dilation of bowel	23	51.1	4	40.0	0.404	0.525
Narrowing & dilatation	29	64.4	1	10.0	9.782	0.002
Matting of bowel loops	8	17.8	1	10.0	0.362	0.548
Terminal ileum thicking/dilatation	16	35.6	0	0.0	5.014	0.025
RIF mass	21	46.7	1	10.0	4.583	0.032
IC junction-thickening	9	20.0	0	0.0	2.391	0.122
IC junction $>90^0$	11	24.4	0	0.0	3.056	0.080
Enteroliths	8	17.8	0	0.0	2.080	0.149

Table 7: Distribution of patients in two groups according to CT findings (n=55)

Feature	Abdominal tuberculosis (n=45)		Other (n=10)		Significance of difference	
	No.	%	No.	%	X^2	P
Liver						
Increased liver size	13	28.9	2	20.0	0.326	0.568
Decreased attenuation/ focal lesion	7	15.5	0	0	1.782	0.182
Focal lesion	5	8.9	0	0	1.222	0.269
Calcification	2	4.4	0	0	0.461	0.497
Spleen						
Increased spleen size	6	13.3	1	10.0	0.082	0.775
Spleen attenuation						
Diffusely heterogeneus	0	0	1	10.0		
Focal lesion only	3	6.7	0	0.0		
Normal	42	93.3	9	90.0		
Multiple hypodense	3	6.7	0	0	0.705	0.401
Calcification	0	0	0	0	-	-
Pancreas						
Increased size	0	0	0	0	-	-
Focal lesions	2	4.4	0	0	0.461	0.497
Multiple hypodense	1	2.2	0	0	0.226	0.634
Calcification	0	0	0	0	-	-
Adrenal						
Increased size	0	0	0	0	-	-
Attenuation	0	0	0	0	-	-
Focasl lesions	0	0	0	0	-	-
Calcification	0	0	0	0	-	-
Lymph node						
Enlarged lymph nodes	43	95.6	6	60.0	10.642	0.001
Involvement of lymph nodes at three or more sites	13	28.9	2	20.0	0.326	0.568
Lymph nodal mass	2	4.4	0	0	0.461	0.497
Calcification	9	20.0	0	0	2.391	0.122
Heterogeneus/disproporionate enhancement	25	55.6	0	0	10.185	0.001

Table 8: Diagnostic efficacy of CT.

CT diagnosis	Final diagnosis		Total
	Tuberculosis	Others	
Tuberculosis	42	2	44
Others total	3	8	11
	45	10	55

CT findings were relatively more sensitive and specific for the findings bowel wall thickening, shouldering, narrowing and dilatation (55.5% to 64.4% sensitive and 90% specific). The findings were less sensitive but highly specific (100%) for RIF mass, terminal ileum thickening, IC junction angle >900 IC junction thickening and enteroliths (sensitivity 17.8% to 46.7%).

A significant association of abdominal tuberculosis was found with bowel –wall thickening, thickening-shouldering, narrowing and dilatation, terminal ileum thickening and RIF mass. None of the associations exept finding enlarged lymph nodes were significant statistically. Although, this finding was highly sensitive (95.6%) yet its specificity was much poor (40%). However, other lymph node features such as lymph nodal mass, calcification and heterogeneous/disproportionate enhancement were highly specific (100%).

Table 9: Comparison of accuracy level of HR-USG and CT.

Outcome	HR-USG (N=55)	CT (n=55)
Correct diagnosis	42(76.4%)	50(90.9%)
Incorrect diagnosis	13(23.6%)	5(9.1%)

X2=4.251 (df=1) p=0.039

However, a review of different CT parameters showed that bowel wall thickeing, narrowing and dilatation, lymph nodal mass, lymph node calcification and lymph node heteroculosis. On the basis of these characteristic findings the diagnostic efficacy of the CT was calculated as follows: This evaluation showed that CT was both more sensitive as well as specific to diagnose abdominal tuberculosis with a high sensitivity of 93.3%, specificity of 80% positive predictive value of 95.5% and negative value of 72.7%. The accuracy of criteria was 90.9%. Accuracy level of CT evaluation was higher (90.9%) as compared to that of USG evaluation (76.4%) and the difference between two methods was found to be significant statistically (p = 0.039).

DISCUSSION

Abdominal tuberculosis (TB) tend to present with non-specific features and can be hard to diagnose (Rai et al).[3] Even in the areas where the disease is endemic, a correct diagnosis is made only in one half of the cases at the initial presentation (Kapoor et al)[4]. The difficulties of diagnosis range apart from just non-specific presenting features to unhelpful laboratory tests, negative results with tuberculin skin tests and Ziehl-Neelsen staining and false-negative ultrasound (wilairatana et al).[5] In view of complexity of its diagnosis, it has posed a challenge to medical diagnostics. Considering this difficulty in diagnosis, some researchers have suggested invasive diagnostic procedures such as diagnostic laparoscopy as the procedures of choice for confirmed diagnosis (Rai et al)[3], on the other hand some have advocated the use of non-invasive methods for diagnosis of this challenging task (petrou and vassiliu,).[6]

Sonography remains the initial, non-invasive imaging modality with high sensitivity of imaging peritoneal tuberculosis. Computed tomography, barium studies, endoscopy, microbiological, histopathological and molecular techniques are used in combination to establish the diagnosis in patients with high degree of clinical suspicion of abdominal tuberculosis (hewavithana, et al).[7]

Both sonography as well as computed tomography have their own benefits and limitations (Yu et al).[8]

The prevalence of abdominal tuberculosis among clinically suspected cases, as observed in present study was 81.8%. In a study by Agarwal et al., the prevalence of abdominal tuberculosis was observed to be 65.4%.[9] In another study, Patel et al. reported the prevalence of active extrapulmonary tuberculosis to be 63.7% among clinically suspected cases.[10] Both these studies had a high prevalence of HIV patients, owing to compromised immune status, some of the clinical features might mimic those suggestive of tuberculosis and hence the clinical suspicion is higher as compared to that in otherwise healthy individuals enrolled in present study.

In present study, the age of clinically suspect patients ranged from 15 to 55 years. No age wise predilection between confirmed cases of abdominal tuberculosis and other diagnoses was observed. Zissin et al. (2001) in their series reported the age of patients to be between 20 to 85 years, while Uygur-bayramicli et al in their series reported the age range of patients to be between 15 and 65 years.[11,12] Despite this wide range of age in our study, maximum prevalence of abdominal tuberculosis was in age groups 21-40 years, thus mimicking the prevalence rates similar to pulmonary tuberculosis which effect the population in most productive years of life (WHO).[13] Khan et al. also found most of the cases of abdominal tuberculosis to be young adults in their productive years of life.[14]

Statistically, no significant gender difference was observed between two groups in this tudy. Uygur-bayramicli et al. in their series of 31 patients reported 14 to be females and 17 to be males.[12] In another study Zissin et al. reported a relatively balanced gender wise distribution with 10 men and 9 women in their series.[11] Contrary to the findings in present study, Chalya et al. reported 57.8% of the patients in their series to be males. Thus, the findings suggest that abdominal tuberculosis

could affect either gender with no specific gender wise discrimination.[13]

Peritoneal thickening and dilated bowel have been reported to be one of the key and characteristic feature of USG for diagnosing peritoneal tuberculosis while small bowel mesenteric thickening with increased echogenicity might indicate early abdominal tuberculosis on USG. In present study these features were found to be positive in higher proportion of patients with abdominal tuberculosis and hence provided a good diagnostic efficacy of high resolution USG for diagnosing peritoneal tuberculosis.

In essence, wall thickening is one of the most common USG findings in cases of intestinal tuberculosis (lee et al.) and the findings of present study also substantiated the same thus showing a good diagnostic efficacy of USG in diagnosing intestinal tuberculosis.[14]

In present study ascites and ascites septa-debris were found to be positive in a good number of cases with or without abdominal tuberculosis observed on USG. Uygur-bayramicli et al. also observed most common abdominal USG finding to be ascites and hepatomegaly.[12] In agreement to our study, they also observed that USG studied alone are not sufficient to diagnose abdominal tuberculosis and the final diagnosis could be achieved only through a combination and algorithm based on clinical signs, laboratory, radiological and endoscopic methods.

In search of a more sensitive and more specific test, we carried out our investigations on computed tomography too. Through the help of CT we could reduce the burden of false positivity by 80%. Thus, CT scan was found to be a better utility in our study as compared to high resolution sonography. These findings are in agreement with the observations of Shiekh et al. who showed that compared to sonography, computed tomography has a better diagnostic accuracy in detecting abdominal tuberculosis.[15] They also found that ultrasound gave useful information but could not completely replace CT as it detected less wall thickening and lymph node abnormalities then CT screening which is again in agreement to our observations. In present study, CT helped to recognize disorganized enhancement of lymph nodes and helped to differentiate between tubercular and non-tubercular cases with utmost accuracy (100%). Similar observations were made by Epstein and Mann.[16]

Our findings also support the observations of Gulati et al who observed that computed tomography (CT) evaluation is singularly informative as it demonstrates involvement of the bowel, peritoneum, lymph nodes, and solid organ in a single examination.[17]

The high quality of images obtained by computed tomography, especially those involving soft tissue provide better information about the inter-abdominal including intestinal and extra-intestinal structures and hence can be used for diagnosis abdominal tuberculosis in general and in its differential diagnosis in particular.

CONCLUSION

Computed tomography is useful in diagnosis of both intestinal and extra-intestinal abdominal tuberculosis and can be recommended for use in routine practice following further substantiation in a large sample size with varied spectrum of abdominal tuberculosis and after verifying the results in a substantial number of control patients.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Husain A, Firdaus H, Panday P. Study of Comparison of high resolution sonography and computed tomography in evaluation of abdominal tuberculosis among patients in Lucknow, Uttar Pradesh, India. Int Surg J 2018;5:1713-9.