

## THREE-DIMENSIONAL COMPUTED TOMOGRAPHIC DIAGNOSIS OF COLOVESICAL FISTULAE

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**Introduction:** Colovesical fistulae are the most common type of fistulous communication between the urinary bladder & the bowel. The relative frequency of colovesical fistulae is difficult to ascertain because multiple disease processes could be complicated by such fistulae. The main purpose of this study is to investigate the role of 3-dimensional tomographic computed reconstruction in diagnosis of colovesical fistulae.

**Materials & methods:** We compared 3-dimensional CT images of colovesical fistulae to conventional CT images in 4 patients. the records of these 4 patients were also reviewed retrospectively with regards to clinical picture , diagnostic studies & surgical repair.

**Results:** The etiology of colovesical fistulae was sigmoid diverticulitis in 3 cases & bladder carcinoma in the fourth case. Successful surgical repair was facilitated by pre-operative 3-dimensional CT images.

**Conclusions:** CT scan should be included as part of the initial evaluation of patients with suspected colovesical fistulae. Three-dimensional CT reconstruction provides superior spatial details & can clarify complex anatomical relationships pre-operatively which increases the surgeon's comfort during surgical repair of these cases.

**Keywords:** Fistula, enterovesical, radiography .

### INTRODUCTION

ENTEROVESICAL fistulae present at a rate of 2-3/10000 surgical hospital admissions <sup>(1)</sup>. Colovesical fistulae are the most common of enterovesical fistulae ; such that they are 10-20 times more common than fistulae between the small intestine & the bladder <sup>(2)</sup>. About two thirds of colovesical fistulae result from sigmoid diverticulitis , such that it's estimated that 2% of patients with diverticulosis develop colovesical fistulae<sup>(3)</sup> . Colon cancer accounts for about 20% of colovesical fistulae . Other etiologies include Crohn's disease, radiation enteritis, bladder cancer , trauma & tuberculosis <sup>(2,3)</sup> .

Different diagnostic methods have been proposed for colovesical fistulae , yet diagnosis is still difficult & its management is complicated <sup>(4)</sup>. Computed tomography (CT) scans of the abdomen & pelvis have been the most accurate imaging modality for demonstration of colovesical fistulae <sup>(4-8)</sup>. However surgical correction can be hindered by fistula complexity , presence of extravesical soft tissue mass & proximity of the fistulous tract to the ureters &

other pelvic structures <sup>(5)</sup>.

IN THIS STUDY we present our experience with 3-dimensional CT reconstruction in enhancing pre-operative understanding of colovesical fistulae & their local anatomy that contributed much to the performed surgical procedures.

### PATIENTS AND METHODS

This study included 4 patients with colovesical fistulae. All patients were subjected to thorough clinical examination & history taking . Laboratory investigations included urinalysis, urine culture & sensitivity , complete blood picture & blood chemistry. Oral charcoal test was performed to all patients by ingestion of 4 tablets of charcoal & observing the colour of urine . The imaging modalities performed to all patients were excretory urography, barium enema & abdomeno-pelvic CT utilizing conventional images & comparing them to 3-dimensional reconstruction images in all patients. A spiral CT machine was used. Conventional images were performed using

intravenous iohalme melgumine contrast & gastrointestinal diatrizoate melgumine / diatrizoate sodium contrast. Immediately after bowel & vascular opacification 1cm contiguous axial slices were obtained rapidly during one or two breath holds, about 15 slices were taken in the pelvis. Later 3-dimensional reconstruction was performed utilizing the 1cm slices which were then subdivided to 1-2mm increments (smaller slices) & these whole data are then sent to a special computer workstation to perform the 3-D images using a surface reconstruction technique. At the workstation, the slices showing each organ or structure needed to be included in the reconstruction is chosen separately e.g. first those showing the urinary bladder was chosen then those showing the ureters then those showing the colon then those showing the potential region of the fistula & each is separately reconstructed & given a different shade according to the computer capabilities.

Finally the whole 3-D reconstructed image is put together & can be rotated in any desired plane.

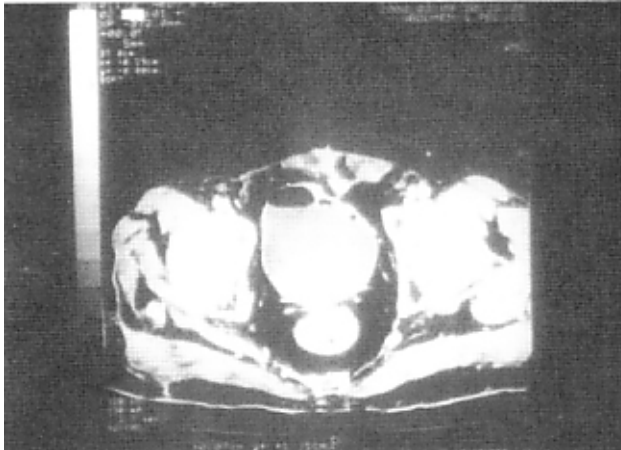
Two endoscopic procedures were performed ; cystoscopy & sigmoidoscopy with biopsy from any suspicious areas.

## RESULTS

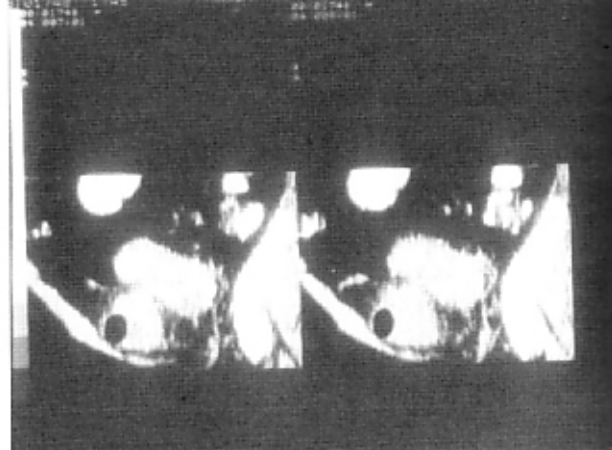
This study included 4 male patients with colovesical fistulae. Their age ranged from 52 to 68 years ( mean 61.5 years ). The fistula in 3 cases was caused by sigmoid diverticulitis while bladder carcinoma was the cause in the fourth case. The clinical manifestations & different diagnostic modalities used are summarized in (Table 1).

**Table (1): Diagnostic studies utilized in the evaluation of Colovesical fistulae.**

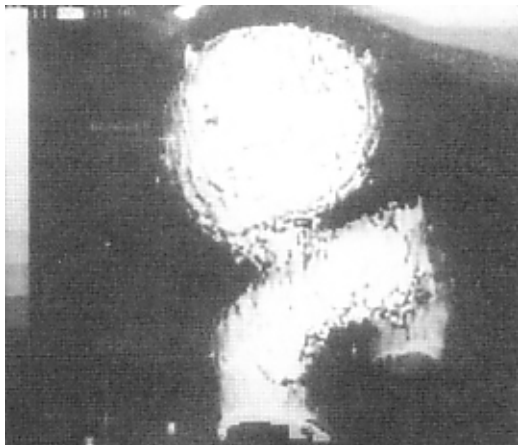
	<i>Case 1</i>	<i>Case 2</i>	<i>Case 3</i>	<i>Case 4</i>
1.Symptoms & signs	Fecaluria, pneumaturia, irritable voiding symptoms, diarrhea, malodorous urine.	Pneumaturia, irritable voiding symptoms, suprapubic pain, malodorous urine.	Pneumaturia, fecaluria, irritable voiding symptoms, suprapubic pain, malodorous urine.	Gross Hematuria, irritable voiding symptoms, suprapubic pain.
2.Urinalysis/ Culture&Sens	Pus in urine , Vegetable matter in urine, rec. UTI with enterobacteriaceae.	Pus in urine , Vegetable matter in urine, rec. UTI with enterobacteriaceae	Pus in urine , Vegetable matter in urine, rec. UTI with enterobacteriaceae	RBCs > 100/HPF Pus in urine , Vegetable matter in urine, rec. UTI with enterobacteriaceae
3.Oral Charcoal test	- Black urine was observed - Charcoal was microscop. detected in centrifuged urine	- Black urine was observed - Charcoal was microscop. detected in centrifuged urine	- Black urine was observed - Charcoal was microscop. detected in centrifuged urine	- Black urine was observed - Charcoal was microscop. detected in centrifuged urine
4. IVU	Normal upper tracts, unremarkable cystogram.	Normal upper tracts, unremarkable cystogram.	Normal upper tracts, unremarkable cystogram.	Early left hydronephrosis, filling defect in left lateral wall in cystogram.
5. Barium enema	Sigmoid diverticular disease with narrow lumen & thickened walls	Sigmoid diverticular disease with narrow lumen & thickened walls	Sigmoid diverticular disease with narrow lumen & thickened walls	Irregular stenotic segment of sigmoid colon with marked thickened walls.
6. CT abdomen & pelvis	Findings are described later	Findings are described later	Findings are described later	Findings are described later
7. Cystoscopy & biopsy	Presence of food particles in bladder, sessile growth in left bladder dome, biopsy: hyperplastic Trans. ep. with bullous oedema	Presence of food particles in bladder sessile growth in left bladder dome, biopsy: hyperplastic Trans. ep. with bullous oedema	Presence of food particles in bladder sessile growth in left bladder dome, biopsy: hyperplastic Trans. ep. with bullous oedema	Presence of food particles in bladder, Solid growth in lt. lat. wall & dome: biopsy: TCC G3 with muscle invasion, BEUA: T4.
8. Sigmoidoscopy	Sigmoid diverticulitis	Sigmoid diverticulitis	Sigmoid diverticulitis	Narrowing of sigmoid colon with sessile growth, biopsy: TCC G3



*Fig. (1) : CT transverse image showing air in the bladder.*



*Fig.(2) : Axial reconstruction of transverse CT image shows air in the bladder & passage of gastrographin from sigmoid colon to the bladder.*



*Figs. (3 & 4): 3- dimensional CT reconstruction demonstrating the fistulous communication between the bladder dome & the infero-medial aspect of the sigmoid , while both ureters are patent & away from the fistulous mass. Note the ability of the computer system to rotate the organs in any desired plane for better visualization of the fistula.*

Conventional CT images of the abdomen & pelvis in the three cases diagnosed as sigmoid diverticulosis showed (i) multiple diverticulae in the left colon, (ii) focal colonic thickening with narrowing & irregularity of the lumen, (iii) presence of a mass (proved to be inflammatory after fistula excision) interposing between the mid sigmoid & the bladder dome, (iv) passage of air & gastrographin from the sigmoid colon to the bladder (before intravenous injection of contrast material) ( Figs. 1& 2 ).

The 3-dimensional reconstruction of the conventional CT images clearly demonstrated a fistulous communication between the infero-medial aspect of the mid sigmoid & the

dome of the bladder while both ureters were patent & not included in the fistulous mass. The small bowel loops were also not included in the fistula (Figs. 3 & 4 ).

Whereas the fourth case diagnosed as bladder carcinoma, conventional CT images showed a bladder growth infiltrating the dome & adjacent left lateral wall of the bladder, the mass extended extravesical & infiltrated the adjacent sigmoid colon, at the site of invasion the colon was markedly thickened & stenotic with passage of air & gastrographin from the colon to the bladder. The malignant mass was seen ending medial to the left ureter but not invading it. The pelvic lymph nodes on the left side were

enlarged, there were no liver metastases. The left kidney showed early hydronephrotic changes. The 3-dimensional reconstruction images demonstrated a fistulous communication between the bladder dome & adjacent left lateral wall & the mid sigmoid. The extent of the malignant mass was demonstrated & it was not invading the pelvic wall nor the left ureter nor the small bowel.

The 4 cases were managed surgically in one stage. In cases with diverticular disease; the involved segment of sigmoid colon was resected together with the fistulizing mass & partial cystectomy; primary reanastomosis of the colon & closure of the bladder were performed with interposition of an omental flap between the bladder & the sigmoid colon. Whereas in the case with bladder carcinoma ; cystoprostatectomy & left pelvic lymphadenectomy was performed , excision of the malignant fistulous mass & the infiltrated sigmoid segment; together with rectal bladder urine diversion & terminal sigmoid colostomy.

## DISCUSSION

Colovesical fistula is a relatively uncommon complication of pelvic malignancies, diverticulitis of the colon, radiation enteritis, Crohn's disease or trauma <sup>(2,6)</sup>. Colovesical fistulae occur more commonly in males, with a male to female ratio of 3:1. The lower incidence in females is probably a reflection of the protective effect of the uterus & adenexa as a physical barrier to fistulization from diseased bowel <sup>(4)</sup>. This condition occurs mainly in the sixth & seventh decades of life, when it's related to the development of diverticulitis & malignancy <sup>(2)</sup>. In the present study all patients included were males with a mean age of 61.5 years. Sigmoid diverticulosis was the cause of colovesical fistula in 3 patients while bladder cancer was the cause in the fourth case.

The classic presentations of colovesical fistulae are pneumaturia & fecaluria in 63% & 43% of patients respectively. Other less specific but more common presentations may occur as recurrent urinary tract infection (UTI) & irritative voiding symptoms in 95% & 70% of patients respectively <sup>(2-4)</sup>. In the present study recurrent UTI & irritative voiding symptoms occurred in all cases followed by pneumaturia (3/4 cases) & fecaluria (2/4 cases). Gross Hematuria occurred in one case with bladder carcinoma.

The oral charcoal test is a sensitive test to the presence of fistula but provides no information as to the location or nature <sup>(3,4)</sup>. In the present study black urine was observed in all patients after 12 hours of ingestion of charcoal tablets.

Different imaging & endoscopic procedures have been used to diagnose colovesical fistulae but most are either poorly sensitive or give little information to the site & nature of the fistula <sup>(5,6)</sup>. Intravenous urography (IVU) is not much

helpful in diagnosis , barium enema rarely reveals a fistula but is helpful in demonstrating the nature & extent of colonic disease <sup>(3,4,6)</sup>. Although sigmoidoscopy is essential in every case of suspected colovesical fistula; its accuracy in diagnosis is only about 10%, yet it's helpful in determining the nature of bowel disease that caused the fistula <sup>(4,6)</sup>. Cystoscopy is much more accurate , showing changes as erythema & bullous edema around an overt fistula in about 75% of cases <sup>(3,6)</sup>. In the present study IVU & barium enema gave unremarkable findings for diagnosis of the fistula, however barium enema showed a stenotic sigmoid segment in all cases & diverticular disease in 3 cases.

Cystoscopy in all cases revealed food particles in the bladder; in 3 cases there was erythema & bullous edema in the dome of the bladder which proved to be inflammatory on biopsy, whereas the fourth case showed a solid growth in the dome & left lateral wall which proved to be invasive transitional cell carcinoma (TCC) grade III on biopsy , however in the 4 cases no obvious fistula could be visualized cystoscopically. Sigmoidoscopy in 3 cases showed diverticular disease with non-specific inflammatory changes on biopsy, whereas in the fourth case with bladder cancer a sessile growth was observed which proved to be poorly differentiated TCC ; however in the 4 cases no obvious fistula could be visualized endoscopically.

CT scan of the abdomen & pelvis is the most sensitive test for detecting colovesical fistulae, it can demonstrate small amounts of air or contrast material in the bladder, localized thickening of the bladder wall & sigmoid , an extraluminal mass adjacent to the bladder. Also CT scans are useful in diagnosis of the etiology of the fistula & staging in case the fistula is secondary to malignancy <sup>(4,6-8)</sup>. However these conventional CT images do not provide a 3-dimensional image which may be invaluable in diagnosis of colovesical fistulae providing an accurate comprehensive view of the fistula , demonstrating the exact position of the ureters & their relation to the fistula, giving an advanced warning of multiple potential fistulous tracks & the course of these tracks also demonstrating the relation of small bowel to the fistulizing mass & whether bowel loops are included in the fistula or not which may complicate surgical reconstruction <sup>(5)</sup>. In the present study conventional CT images of the abdomen & pelvis provided details about the etiology of colovesical fistulae included; 3 cases due to sigmoid diverticulosis & the fourth case was caused by bladder carcinoma invading the adjacent sigmoid colon. It also demonstrated air & gastrographin in the bladder, focal bladder & sigmoid wall thickening and apposition with an extravescical soft tissue mass. Other details were provided in the case with bladder carcinoma in the form of pelvic lymph node enlargement on the left side but there was no liver metastases. Additional details concerning the local anatomy of fistulae were obtained when utilizing 3-dimensional image reconstruction namely the 3-D images showed a

single fistulous track extending between the infero-medial aspect of the mid sigmoid & the bladder dome to the left , the small bowel was not included in the fistulizing mass & both ureters were patent & away from the fistulizing mass although in case with bladder cancer the mass was seen ending close & medial to the left ureter but not invading it. These additional pre-operative details facilitated a single stage surgical repair in all cases & there was no need for pre-operative cystoscopic placement of ureteric catheters to avoid injury of the ureters during surgery.

## CONCLUSIONS

CT scan of the abdomen & pelvis is the most sensitive test for detecting a colovesical fistula & it should be included in the evaluation of patients with suspected colovesical fistulae.

Three-dimensional CT reconstruction must be used to improve pre-operative appreciation of the anatomical course of colovesical fistulae & its relations to different abdominal & pelvic structures.

These anatomically superior images increase the surgeon's comfort level during surgical repair of these complex cases thus reducing the operative time & providing higher success rates .

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