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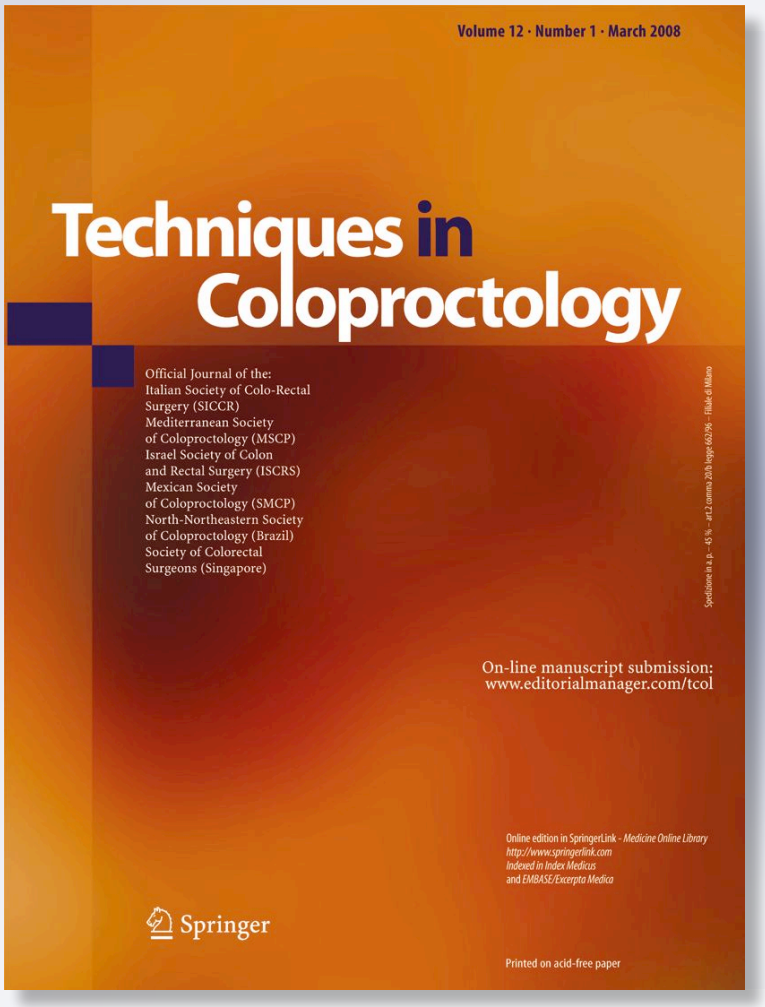

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ORIGINAL ARTICLE

Colovaginal and colovesical fistulae: the diagnostic paradigm

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Abstract
Background Colovaginal and colovesical fistulae (CVF) are relatively uncommon conditions, most frequently resulting from diverticular disease or colorectal cancer. A high suspicion of a CVF can usually be obtained from an accurate clinical history. Demonstrating CVF radiologically is often challenging, and patients frequently undergo a multitude of investigations prior to definitive management. The aim of this study was to develop an algorithm for the investigation of suspected CVF in order to improve diagnosis and subsequent management.
Methods Thirty-seven patients from a single NHS Trust with a diagnosis of colovaginal or colovesical fistula were included in the study. Clinical records and imaging were reviewed retrospectively, and data on demographics, symptoms, investigations, management and outcome were collated.
Results A total of 87.5% patients with a colovesical fistula presented with pathognomic symptoms of faecaluria or pneumaturia. The commonest aetiologies were diverticular disease (72.9%), colonic and gynaecological neoplasia (10.8% each). Computerised tomography (CT) was the most frequently performed investigation (91.9%) and was most sensitive in detecting the fistula (76.5%) and underlying aetiology (94.1%). Colonoscopy was most sensitive in detecting an underlying colonic malignancy (100%). Resectional surgery was performed in 62.1% of cases, although morbidity and 1-year mortality was significant, with rates of 21.7 and 17.4%, respectively.
Conclusions The diagnosis of CVF is predominately a clinical one, and patients with a suspected CVF are over-investigated. Investigations should be focused on determining aetiology rather than demonstrating the fistulous tract itself. We propose that, in the majority of cases, CT and lower gastrointestinal endoscopy should suffice.

Keywords Fistula · Diverticular disease · Colorectal cancer · Investigation · Diagnosis

Introduction

Colovesical and colovaginal fistulae (CVF) are abnormal, epithelium-lined connections between the colon and urinary bladder, ureter or vagina [1]. They are uncommon, but cause significant morbidity and mortality, with reported morbidity rates ranging from 4 to 46% and mortality rates from 0 to 30% [2]. Fistulae may also form between the bowel and uterus, but colouterine fistulae are much less common than either colovesical or colovaginal fistulae [3]. Rarely, a coloureteric fistula may form between the colon and ureter or a complex fistula with a fistulous track that involves more than two organs, e.g., colovesicocutaneous fistula [4]. CVF most commonly affect the sigmoid colon [5] and are typically caused by bowel disease, although pathologies affecting the bladder or female genital tract may also lead to fistula formation [6]. Published studies have shown that between 62 and 78% of CVF are due to

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diverticular disease, and that colon cancer is the second most common cause, with a reported frequency of 12–27% [2, 7–11]. Other aetiologies of CVF formation include Crohn's disease, bladder cancer, radiotherapy, previous pelvic surgery and foreign bodies [12, 13]. The incidence of fistulae in patients with diverticular disease is around 2–4% [7], whereas fistula formation only occurs in 0.6% of patients with a colorectal carcinoma. Colovesical fistulae are commoner in men with a male/female ratio of around 3:1. This is due to the interposition of the uterus and adnexae between the sigmoid colon and bladder in females. Higher rates of both colovesical and colovaginal fistulae have been reported in women who have previously undergone a hysterectomy [3, 14].

The diagnosis of CVF is predominately a clinical one. Commonly reported symptoms include a history of faeculant vaginal discharge or the passage of vaginal gas in the case of colovaginal fistulae and pneumaturia, faecaluria and recurrent urinary tract infections (UTI) in colovesical fistulae. Indeed, pneumaturia and faecaluria are virtually pathognomic of a colovesical fistula. Published studies report that faecaluria, pneumaturia or both are seen in up to 92% of cases of colovesical fistula [2, 8].

The presence of CVF is usually difficult to demonstrate using routine radiological and endoscopic modalities, and patients with a suspected CVF are frequently over-investigated, undergoing various investigations prior to diagnosis. In some cases, the same investigations are performed repeatedly in the hope that the fistula will be identified.

The aim of this study was to evaluate the diagnostic yield of the various investigations performed on patients with an eventually proven CVF at our institution and to assess whether an algorithm could be introduced to simplify the diagnostic pathway and reduce the number of investigations performed overall.

Materials and methods

The study was conducted at an acute hospital trust in north London, covering two large district general hospitals providing both general and specialist surgical services. Patients diagnosed with a colovesical or colovaginal fistula between 2003 and 2009 were identified retrospectively from the institution's database using the respective ICD-10 codes. Those with unobtainable clinical notes were excluded from the study. Medical records were reviewed retrospectively, and history at presentation, demographic, diagnostic, radiological and operative information was obtained and recorded using Microsoft Access (Microsoft, WA, USA). The study was approved by the Trust Audit Department.

In total, 43 patients were identified from computerised coding records, and of these, 37 were included in the study. Five patients were excluded because they had a diagnosis of an enterocutaneous or colocutaneous fistula rather than a CVF, and 1 patient's clinical notes were unavailable. Of the 37 patients, 16 were men and 21 were women. Demographic data are shown in Table 1.

Median age at presentation was 73 years 6 months (range: 45 years. 11 months–90 years. 11 months). Twenty-four patients (64.9%) were found to have a colovesical fistula and 11 patients had a colovaginal fistula (29.7%). One female patient (2.7%) had a colouterine fistula and another patient (2.7%) had both a colovaginal and a colovesical fistula.

Results

Underlying aetiology

The commonest aetiology (Table 2) underlying the development of the colovesical or colovaginal fistula was diverticular disease (72.9%), followed by colorectal malignancy (10.8%), endometrial cancer (5.4%) and Crohn's disease (2.4%). Two patients (5.4%) developed an iatrogenic CVF postoperatively; one following a low-rectal anastomotic leak after anterior resection, which subsequently led to the formation of a rectovaginal fistula and one following a stapled haemorrhoidopexy.

Table 1 Demographic data ($n = 37$)

Age (years) [median (range)]	73.5 (45.9–90.9)
Sex (M/F)	43.2:56.8
Presentation	**Patients (%)**
Outpatient clinic referral	56.8
Inpatient referral	8.1
Emergency admission	35.1

Table 2 Aetiology

Diverticular disease	72.9%
Colorectal cancer	10.8%
Endometrial cancer	5.4%
Post-operative	5.4%
Ovarian cancer	5.4%
Crohn's disease	2.7%

Symptoms

A wide range of symptoms was reported at presentation (Table 3), the most frequent being change in bowel habit (54.1%), recurrent UTIs (48.6%), pneumaturia (43.2%) and faecaluria (37.8%). Of the patients who were subsequently diagnosed with a colovesical fistula ($n = 24$), 66.6% reported pneumaturia and 58.3% reported faecaluria at presentation, whilst 90.9% of those patients who were diagnosed with a colovaginal fistula ($n = 11$), reported faeculant vaginal discharge. In total, 87.5% of patients with a colovesical fistula reported either faecaluria or pneumaturia or both at the time of presentation.

Investigations

A total of 103 investigations aimed at identifying CVF or the underlying aetiology were performed on the 37 patients included in the study (Table 4), with a mean of 2.78 investigations per patient (range: 1–6). The most frequent investigation performed was a CT scan (91.9% of cases), which had a sensitivity of 76.5% in diagnosing CVF. Three (8%) of these were CT colonoscopy studies. Lower gastrointestinal endoscopy (colonoscopy or flexible sigmoidoscopy) was performed in 45.9% of cases and, although a fistula was visualised in only one instance, the underlying aetiology of the CVF was correctly diagnosed in 64.7% and was the most sensitive investigation in detecting a colonic malignancy (100%). CT scanning and lower gastrointestinal endoscopy had similar accuracy in detecting diverticular disease, with rates of 76.5 and 70.6%, respectively. However, only 45.9% of the patients in our series underwent a colonoscopy or flexible sigmoidoscopy, which is

Table 3 Presenting symptoms

Presenting symptoms	$n = 37$
Change in bowel habit	20 (54.1%)
Recurrent urinary tract infections	18 (48.6%)
Abdominal pain	16 (43.2%)
Pneumaturia	16 (43.2%)
Dysuria	15 (40.5%)
Faecaluria	14 (37.8%)
Vaginal discharge	11 (29.7%)
Haematuria	11 (29.7%)
Vaginal air	7 (18.9%)
Weight loss	6 (16.2%)
Faecal incontinence	5 (13.5%)
Systemic sepsis	5 (13.5%)
Peritonism	4 (10.8%)
Rectal bleeding	1 (2.7%)
Tenesmus	1 (2.7%)

Table 4 Investigations and findings ($n = 103$)

Investigation	Number of patients	Fistula demonstrated (sensitivity) (%)	Underlying aetiology defined (%)	Malignancy identified[a] (%)	Sensitivity in detecting malignancy	Stricture identified (%)	Inflammation (%)	Diverticulosis identified (%)	Abscess (%)
CT	34 (91.9%)	76.5	94.1	5.9	66.6% (2/3)	2.9	52.9	76.5	5.9
Lower gastrointestinal endoscopy	17 (45.9%)	5.9	64.7	11.8	100% (2/2)	23.5	29.4	70.6	
Cystoscopy	15 (40.5%)	40.0	0	0		0	20.0	0	0
Cystography	4 (10.8%)	50.0	0	0		0	0	0	0
Intravenous urography	1 (2.7%)	100	0	0		0	0	0	0
Contrast enema	13 (35.1%)	30.8	53.8	0		0	0	53.8	0
MRI	6 (16.2%)	16.6	50.0	33.3	100% (2/2)	16.7	50.0	16.7	0
Ultrasound	6 (16.2%)	0	16.7	0		0	0	0	0
Rigid sigmoidoscopy	5 (13.5%)	0	0	0		0	20.0	0	0
EUA	2 (5.4%)	100	0	0		0	0	0	0
Diagnostic laparoscopy	1 (2.7%)	100	0	0		0	0	0	0

CT computed tomography, *MRI* magnetic resonance imaging, *EUA* examination under anaesthesia

[a] Malignancy identified on investigation is the number of patients in which a colorectal, pelvic and urological malignancy was detected. We excluded any incidental malignancy that was unlikely to have contributed to the development of a colovesical or colovaginal fistula, although this was not applicable in any of the 37 cases

Table 5 Identification of fistula

Investigation	Fistula demonstrated (sensitivity)	Diagnostic findings indicative of CVF			
		Fistulous tract visualised (%)	Air in bladder (%)	Faeces in bladder (%)	Contrast extravasation (%)
CT	26 (76.5%)	65.4	76.5	0	7.7
Lower gastrointestinal endoscopy	1 (5.9%)	100	0	0	0
Cystoscopy	6 (40.0%)	83.3	33.3	16.7	0
Cystography	2 (50.0%)	100	50.0	0	100
Intravenous urography	1 (100%)	0	0	0	100
Contrast enema	4 (30.8%)	100	0	0	100
MRI	1 (16.6%)	100	0	0	0
Ultrasound	0 (0%)	0	0	0	0
Rigid sigmoidoscopy	0 (0%)	0	0	0	0
EUA	2 (100%)	100			0
Diagnostic laparoscopy	1 (100%)	100			0

CVF colovesicular/colovaginal fistula, *CT* computed tomography, *MRI* magnetic resonance imaging, *EUA* examination under anaesthesia

surprising given that the predominant aetiologies of CVF are colonic in origin.

Cystoscopy was performed in 40.5% of patients (62.5% of patients with a colovesical fistula) and had sensitivity of 40% in detecting a vesicular fistulous orifice, although no bladder tumours were detected by cystoscopy in our series. Two patients (5.4%) who underwent rigid cystoscopy also had ureteric J–J stents placed simultaneously, one due to ureteric obstruction secondary to Duke's C sigmoid adenocarcinoma and one to permit perioperative ureteric identification.

A total of 35.1% patients underwent a contrast enema, which successfully diagnosed the CVF in 30.8% of cases, although it was less sensitive in diagnosing colonic diverticular disease, with a detection rate of 53.8%, and no colonic malignancies were identified via contrast enema. MRI and ultrasound were each performed in 16.2% of cases, with MRI identifying CVF in one case (16.6%), whilst ultrasound did not identify the fistula on any occasion. Examination under anaesthesia, although only performed in 2 cases, identified the fistula on both occasions.

The findings indicative of CVF on investigations were visualization of the fistulous tract itself, the presence of air or faeces in the bladder or extravasation of contrast administered per rectum or intravesically. These data for the respective investigations are shown in Table 5.

Surgery

Of the 37 patients included in the study, 23 patients (62.1%) underwent definitive surgery with resection or closure of the colovesical or colovaginal fistula (Table 6). Six patients (16.2%) underwent palliative surgery to improve symptoms without undergoing major resection or

Table 6 Surgery ($n = 31$)

Definitive surgery (n = 23)	62.1%
Anterior resection	11 (29.7%)
Without defunctioning stoma	9
With defunctioning ileostomy	2
Sigmoid colectomy	7 (18.9%)
Hartmann's procedure	4 (10.8%)
Left hemicolectomy	1 (2.7%)
Symptomatic control (n = 6)	16.2%
Colostomy	4 (10.8%)
Defunctioning Ileostomy	2 (5.4%)
Conservative management (n = 8)	21.6%
Asymptomatic/minimal symptoms	2 (5.4%)
Unfit for surgery	4 (10.8%)
Patient declined surgery	2 (5.4%)

closure of the CVF, 2 due to patient preference and 4 due to being considered too high risk for major resectional surgery ($n = 4$). All definitive operations and 4 out of 6 palliative operations were performed by 4 experienced consultant-grade surgeons, subspecializing in colorectal surgery. The remaining two palliative operations were performed by senior surgical registrars. Eight patients (21.7%) were managed conservatively, 2 due to minimal symptoms, 2 due to patient preference and 4 because they were unfit for any surgery.

Outcome

Median follow-up was 23 months (range: 1–44 months). Of the 23 patients who underwent definitive surgery, 2 died within 30 days of surgery (8.7%) and a further 2 died within 1 year (8.7%). The 1-year mortality rate was

therefore 17.4%. Thirty-day mortality was attributed to abdominal sepsis in both cases. One of the 2 patients who died within 1 year, died of recurrent metastatic rectal adenocarcinoma and one died of other, unrelated comorbidities. Thirty-day mortality in patients undergoing palliative surgery was 0%. Three patients (50.0%) who underwent palliative surgery died between 1 year and 18 months postoperatively, due to metastatic cancer. Of the 8 patients treated conservatively, 2 died within 1 year due to metastatic adenocarcinoma.

Within the group of patients who underwent definitive treatment, morbidity was 21.7%. One patient suffered an iatrogenic ureteric injury during the initial Hartmann's procedure and underwent ureteric stenting and repair, and 2 patients developed severe pulmonary complications postoperatively, requiring intensive care. Two patients developed recurrence of their fistulae at 3–4 months postoperatively and subsequently underwent defunctioning loop ileostomy. No morbidity was reported in the group of patients who underwent palliative surgery.

Discussion

Colovesical and colovaginal fistulae (CVF) are relatively uncommon conditions. Patients may report a range of symptoms at the time of presentation with a suspected CVF. However, two symptoms, faecaluria and pneumaturia, are pathognomic of a colovesical fistula, and in our series, 87.5% of patients eventually diagnosed with a colovesical fistula reported one or both of these symptoms at presentation, which is consistent with the published literature [2]. The presence of true faecaluria is always due to an underlying colovesical fistula, although in clinical practice, faecaluria can sometimes be mistaken for debris, e.g., secondary to catheterisation or a UTI. Unless recent cystoscopy or urinary tract surgery has been performed, pneumaturia should also be attributed to an underlying fistula. Gas-producing UTIs are exceptionally rare and, when they do occur, are usually due to candidal or gas-producing *E. Coli* infections [15, 16]. Therefore, all patients presenting with pneumaturia should be investigated for a presumed colovesical fistula, otherwise a delay in diagnosis may ensue.

In our study, the commonest underlying aetiologies of CVF were colonic diverticulosis (72.9%) followed by colorectal cancer (10.8%) and gynaecological cancer (10.8%): a finding that is concordant with previously published series [2, 7]. Iatrogenic injury, especially following pelvic gynaecological or colorectal surgery (5.4%), may also lead to the formation of a CVF.

Radiological identification of a CVF can be particularly difficult. There is currently little consensus in the literature regarding the gold standard imaging modality for the detection of CVF [6, 17]. Our results demonstrate that there is considerable variety in the investigations performed for a suspected CVF in our institution, and patients frequently undergo a number of investigations prior to diagnosis. It is important to distinguish investigations aimed primarily at detecting of the fistula, such as cystography and contrast enemas and those aimed at defining the underlying aetiology or a combination of the two, such as CT scanning and colonoscopy.

In our series, we found that CT scanning was the most reliable investigation of those aimed at the detection of CVF, with a sensitivity of 76%, although the fistulous tract was only visualised in 64%, with the remainder diagnosed by the presence of intravesical air. Comparable studies have reported disparate sensitivities of between 10% and 80% in the detection of CVF [6, 18] and, although not directly comparable, the sensitivity of CT scanning was found to be 68.4% in large published series assessing the accuracy of imaging modalities in the detection of internal fistulae in Crohn's disease [19]. Our series also demonstrated that CT has a high sensitivity in delineating the underlying aetiology of the CVF (94%), which is comparable to other published studies [6, 18]. Further advantages of CT scanning lie in its ability to evaluate extra-luminal disease, unlike contrast studies [19, 20], and aid future operative planning by defining the surrounding anatomy.

The main aim of lower gastrointestinal endoscopy (colonoscopy and flexible sigmoidoscopy) in patients with a suspected CVF is to diagnose the underlying aetiology, rather than to identify the fistula per se. It is the most sensitive investigation in evaluating the colon lumen, especially in detecting occult carcinoma, and is advantageous in that biopsy of mucosal lesions can be performed [21]. In the context of a CVF, colonoscopy is required to exclude a malignant colonic mucosal lesion and can also assess the extent of diverticular disease, although lower gastrointestinal endoscopy has a low sensitivity for detecting the presence of a CVF, with a rate of 5.8% in our series and rates between 0% and 55% in other published series [2, 6, 18]. In our series, only 45.9% of patients underwent lower gastrointestinal endoscopy, which is somewhat surprising. One explanation is that many patients who present with a suspected CVF are elderly and may not tolerate lower gastrointestinal endoscopy. In this series, 30% of patients were aged >80 years and 51% over 75 years. Additionally, CT colonoscopy was performed on 3 patients (8%), replacing endoscopic colonoscopy, and 13 (35%) underwent double-contrast barium enema (DCBE).

Cystoscopy has been reported to be capable of detecting a fistulous opening in the bladder in 46–87% of patients with a colovesical fistula [6, 9, 18, 21] although, in our series, the detection rate of cystoscopy was slightly lower,

with a sensitivity of 40%. Although cystoscopy is the gold standard investigation in the diagnosis of bladder cancer, bladder cancer is a relatively uncommon cause of colovesical fistulae, accounting for approximately 2–5% of cases [7]. If bladder cancer is suspected, such as in the patient who presents with frank haematuria, then cystoscopy should be performed. Likewise, cystoscopy is an important investigation in the context of a CVF in a patient with known colorectal malignancy and radiological evidence of bladder involvement. When combined with ureteric stenting, cystoscopy can aid intraoperative identification of the ureters in cases where complex pathology is likely to be encountered [22], such as with periureteric or perivesical tumours, or can relieve ureteric obstruction due to pelvic pathology, which may also be the underlying cause of the CVF [23].

Rectal contrast studies have been reported to delineate a CVF in 20–44% of cases, and our results correlate with these, with a detection rate of 31%. However, several studies have demonstrated that colonoscopy is superior to double-contrast barium enema (DCBE) in both the detection of colonic polyps and colorectal cancer, especially in high-risk patients [24–27]. Garcea et al. [6] suggested that barium enema combined with colonoscopy should be the initial investigations in the diagnostic pathway of CVF. However, given that lower gastrointestinal endoscopy performed by an experienced operator is superior to double-contrast barium enema (DCBE) in the detection of colorectal malignancy, and in addition permits tissue diagnosis, we suggest that endoscopy should be favoured over DCBE in the investigation of a suspected CVF. Cystography can detect colovesical fistulae in 40–57% of cases [2, 6], although it has limited use in the diagnosis of the underlying aetiology.

MRI is frequently used to image complex fistulae in Crohn's disease. Ravichandran et al. [17] reported a sensitivity of 100% in detecting both the presence of a colovesical fistula and the underlying aetiology in a small series of 19 cases. In our series, only 6 patients underwent MRI and the accuracy was much lower, with a CVF detection rate of 16.6%. It is not clear whether MRI offers any significant benefits over CT and, given that CT is more readily available, MRI should be used as a second-line investigation for the diagnosis of a CVF, such as in the imaging of complex fistulae.

The management of a CVF is, to some extent, determined by the underlying aetiology. It is suggested that resection of the diseased segment of colon is essential in reducing the risk of fistula recurrence. Definitive surgical options include either a resection/primary anastomosis, primary anastomosis with a temporary diverting stoma, Hartmann's procedure or 3-stage procedures. Palliative surgical options include either a defunctioning ileostomy or colostomy and, together with conservative, non-operative management are usually reserved for patients who are either unfit or do not wish to undergo major resectional surgery. In our series, the overall morbidity in those undergoing definitive resectional surgery was 21.7%, which is comparable to published rates ranging from 6.4 to 49% [5, 6, 9, 10, 21]. Our 1-year mortality in this group was 17.4%, although 2 patients died from problems unrelated to the fistula surgery. This rate is similar to other studies, which reported rates of 0–30% [2, 8, 10, 18, 28].

Proposed diagnostic protocol

One of the primary aims of this study was to develop an algorithm to simplify and speed-up the diagnosis of suspected CVFs, eliminating the routine performance of investigations with a low diagnostic yield. Based on our study and the data available from published literature, we propose a protocol for the investigation and management of a suspected CVF (Fig. 1). Investigations can be divided into those aimed at diagnosing the fistula and those aimed at determining the underlying aetiology. We propose that CT scanning should be the initial investigation of choice in the diagnosis of a suspected CVF due to its high sensitivity and ability to evaluate extra-luminal anatomy. We suggest that CT scanning should be accompanied by lower gastrointestinal endoscopy (colonoscopy or flexible sigmoidoscopy depending on clinical presentation and fitness of the patient) to exclude colonic neoplasia and to help define the underlying aetiology. Arguably, it is more important to determine whether the underlying aetiology of the fistula is benign or malignant, as this has significant implications on subsequent treatment, rather than delineating the fistula tract, which tends not to alter management. In the majority of cases, investigations can be limited to CT scanning and lower gastrointestinal endoscopy. In patients who cannot tolerate lower gastrointestinal endoscopy, CT colonoscopy should be performed.

Although cystoscopy is the gold standard investigation for the detection of bladder malignancy, we suggest that it should not be performed in all the cases of suspected CVF since bladder malignancies only account for a small proportion of CVF in comparison with colon pathologies. Cystoscopy, however, is useful in a number of circumstances and should be undertaken routinely when there is a suspicion of urological malignancy, such as in a patient with frank haematuria, or when there is radiological evidence of a bladder mass or bladder involvement of a colonic cancer. Likewise, if there is a lack of evidence of colon pathology underlying a colovesical fistula, cystoscopy should be undertaken to exclude a bladder tumour.

In cases where initial investigations have failed to demonstrate a CVF and the clinical suspicion is such that

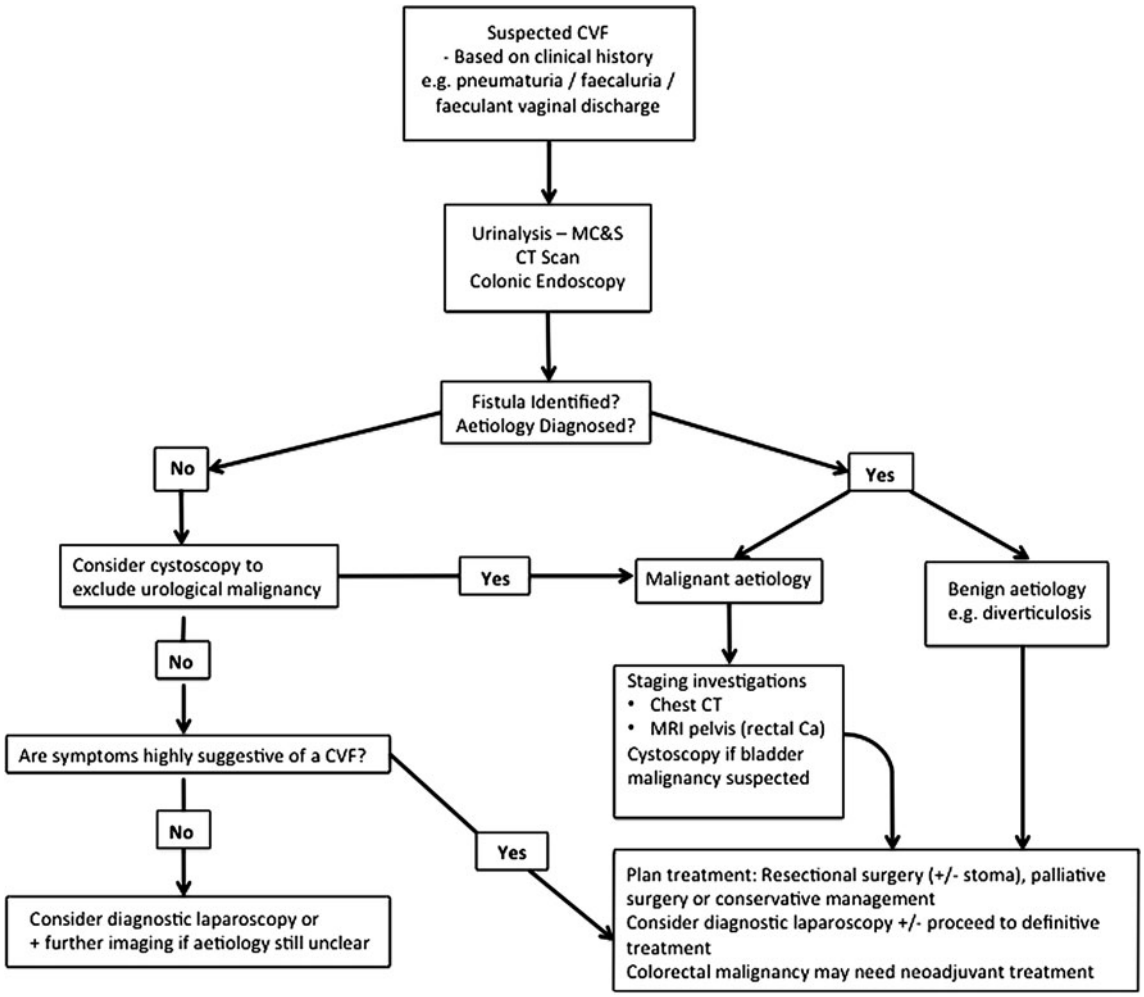

Fig. 1 Proposed algorithm for the investigation of patients with a suspected colovesical/colovaginal fistula

operative treatment cannot be considered without a more conclusive diagnosis, we suggest that progressing to diagnostic laparoscopy should be considered. If a fistula is visualised at laparoscopy, then progression to bowel resection, defunctioning stoma or disconnection of the fistula with omental interposition can occur under the same general anaesthetic, as appropriate. Although the number of patients undergoing EUA or diagnostic laparoscopy in our series was small ($n = 3$), the diagnostic yield was 100%. It is suggested that performing these procedures may reduce the number of investigations undertaken and time spent reaching a definitive diagnosis, and hence treatment in patients where the history is not entirely convincing and demonstration of CVF is proving to be a challenge.

Using other investigative modalities, such as contrast enemas and cystography, is unlikely to add significant information to that provided by CT scanning and lower gastrointestinal endoscopy. Undertaking additional investigations has implications in terms of financial cost and radiation exposure, whilst also prolonging diagnostic time and delaying definitive treatment. We suggest that these investigations cannot be justified routinely.

Conclusions

The diagnosis of CVF is a predominantly clinical one. Investigations should be limited and should be focused on determining the underlying aetiology rather than delineating the fistulous tract itself. Accounting for the fact that diverticular disease and colonic neoplasia are the two commonest causes of CVF, we suggest a diagnostic algorithm for a patient with suspected CVF. In the majority of cases, CT scan and lower gastrointestinal endoscopy should suffice. The CT scan should be performed first, as it can accurately detect the underlying aetiology of the fistula, is the most sensitive investigation in demonstrating the fistulous tract, can identify extra-luminal disease and aids operative planning. It should be followed by lower

gastrointestinal endoscopy to evaluate the colon lumen. Cystoscopy should be performed if there is suspicion of underlying bladder cancer, evidence of bladder involvement in a patient with colorectal cancer or combined with stenting when there is ureteric obstruction or a need to aid identification of the ureters perioperatively.

Over-investigation results in increased costs, more time until treatment, and greater radiation exposure. Other investigative modalities, such as contrast enema and cystography should not be performed routinely as they are unlikely to contribute significantly to the information obtained from CT and lower gastrointestinal endoscopy. MRI should be reserved as a second-line investigation, such as for complex fistulae. Diagnostic laparoscopy may also be useful when the clinical history is not entirely suggestive of CVF, or when aetiology is uncertain after initial investigations and, if a CVF is detected, the surgeon can proceed to treatment under the same general anaesthetic, as appropriate.

Conflict of interest The authors declare that no conflict of interest exists.

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