Introduction

In the United States of America there are 39,220 new cases of rectal cancer diagnosed each year [1]. Low anterior resection is a sphincter-saving procedure undertaken to treat low rectal cancers and can be undertaken laparoscopically or through an open procedure. Morbidity following anterior resection for rectal cancer is common and has been reported in up to 32.6% of cases [2]. Complications following low rectal anastomosis include leak, abscess, fistulae and anastomotic stenosis. Seminal vesicle-rectal (SV-R) fistulation is an uncommonly reported complication and as such there is no algorithm for the management of these patients [3-11]. In this review risk factors that lead to the development of seminal vesicle-rectal fistula are highlighted and management options for this uncommon and challenging morbidity are proposed.

Surgical technique

Laparoscopic ultra-low anterior resection is typically performed with de-functioning loop ileostomy for patients with rectal cancer within 12 cm from the anal verge. Pre-operatively these patients often receive down-staging neo-adjuvant chemo-radiotherapy. Laparoscopic anterior resection is then performed after an interval of six to ten weeks to achieve R0 resection. A double staple technique using linear and trans-anal circular staple devices (e.g., CDH-29 Johnson & Johnson Ethicon) is performed to achieve anastomosis and restoration of bowel continuity. A de-functioning ileostomy is usually performed in the setting of previously irradiated tissue.

Methods

A MEDLINE search was undertaken over the date range 1974 to 2016. Inclusion criteria with search terms ‘fistula’, ‘anterior resection’ and ‘seminal vesicle’ were used. There were 9 articles of relevance which reported a total of 12 cases. All other iatrogenic or cryptogenic fistula was excluded.
Table 1: Clinical Presentation, Risk Factors and Management.

<table>
<thead>
<tr>
<th>Author</th>
<th>Age</th>
<th>Disease Stage</th>
<th>Open or Lap</th>
<th>High or Low</th>
<th>Presenting Symptoms</th>
<th>Evidence of colitis</th>
<th>Day of Presentation</th>
<th>Right or Left vesicle</th>
<th>Imaging</th>
<th>Anti biotics</th>
<th>Urinary Catheter</th>
<th>De-functioned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goldman [3]</td>
<td>76</td>
<td>-</td>
<td>open</td>
<td>low</td>
<td>pneumaturia, testicular pain and frequency</td>
<td>No</td>
<td>28</td>
<td>Right</td>
<td>Cylostream, gastro-graffinena, antegrade vasogram</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Kawasaki [4]</td>
<td>52</td>
<td>-</td>
<td>open</td>
<td>low</td>
<td>pneumaturia, dysuria, fever, melaena and haematuria</td>
<td>No</td>
<td>15</td>
<td>Left</td>
<td>CT, water soluble contrast enema</td>
<td>Yes</td>
<td>Yes</td>
<td>-</td>
</tr>
<tr>
<td>Nakajima [5]</td>
<td>73</td>
<td>T3N0m0</td>
<td>open</td>
<td>low</td>
<td>pneumaturia, testicular pain and fever</td>
<td>No</td>
<td>37</td>
<td>Left</td>
<td>vasogram, fistula graphy, CT</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Nakajima [5]</td>
<td>76</td>
<td>T3N1M0</td>
<td>open</td>
<td>low</td>
<td>pneumaturia, testicular pain and scrotal swelling</td>
<td>No</td>
<td>41</td>
<td>Right</td>
<td>water soluble contrast enema</td>
<td>No</td>
<td>Yes</td>
<td>Yes, urethral</td>
</tr>
<tr>
<td>Nakajima [5]</td>
<td>49</td>
<td>T4N2M0 (invading seminal veside)</td>
<td>open</td>
<td>low</td>
<td>Fever and faecaluria</td>
<td>No</td>
<td>10</td>
<td>-</td>
<td>CT, vasogram via cystoscopic control</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes, ileostomy</td>
</tr>
<tr>
<td>Sykora [6]</td>
<td>66</td>
<td>-</td>
<td>Lap</td>
<td>low</td>
<td>pneumaturia, testicular pain and scrotal swelling</td>
<td>No</td>
<td>11</td>
<td>Bilateral</td>
<td>Contrast irrigoscopy, CT</td>
<td>No</td>
<td>Yes</td>
<td>Yes, suprapubic</td>
</tr>
<tr>
<td>Hiraki [7]</td>
<td>40</td>
<td>-</td>
<td>open</td>
<td>low</td>
<td>Fever, Polyuria</td>
<td>No</td>
<td>14</td>
<td>Left</td>
<td>water soluble contrast enema, CT</td>
<td>No</td>
<td>-</td>
<td>Yes, ileostomy</td>
</tr>
<tr>
<td>Soda [8]</td>
<td>56</td>
<td>T3N0M0</td>
<td>Lap</td>
<td>low</td>
<td>Pneumathia and dysuria</td>
<td>No</td>
<td>14</td>
<td>Left</td>
<td>CT, colonoscopy and fistulography</td>
<td>No</td>
<td>-</td>
<td>No</td>
</tr>
<tr>
<td>Mishima [9]</td>
<td>67</td>
<td>-</td>
<td>Lap</td>
<td>low</td>
<td>Pneumathia, fever and dysuria</td>
<td>No</td>
<td>9</td>
<td>Right</td>
<td>CT</td>
<td>No</td>
<td>Yes</td>
<td>-</td>
</tr>
<tr>
<td>Mishima [9]</td>
<td>82</td>
<td>-</td>
<td>Lap</td>
<td>low</td>
<td>Pneumathia, fever and testicular pain</td>
<td>Yes, C.diff +ve</td>
<td>13</td>
<td>Right</td>
<td>CT</td>
<td>Yes</td>
<td>Yes</td>
<td>-</td>
</tr>
<tr>
<td>Kitazawa [10]</td>
<td>53</td>
<td>T2N0Mo</td>
<td>open</td>
<td>low</td>
<td>Pneumathia, fever and diarrhoea</td>
<td>No</td>
<td>13</td>
<td>Right</td>
<td>CT</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Akahane [11]</td>
<td>73</td>
<td>-</td>
<td>open</td>
<td>low</td>
<td>fever</td>
<td>No</td>
<td>5</td>
<td>-</td>
<td>CT</td>
<td>Yes</td>
<td>-</td>
<td>Yes, ileostomy</td>
</tr>
<tr>
<td>Dixon [11]</td>
<td>67</td>
<td>T3N0m0</td>
<td>Lap</td>
<td>Ultra-Low</td>
<td>pneumaturia, fever, dysuria and frequency</td>
<td>No</td>
<td>53</td>
<td>Left</td>
<td>CT, water soluble contrast enema</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

Compliance with Ethical Standards
- Conflicts of interest
  o Author A declares there he has no conflicts of interest
  o Author B declares there he has no conflicts of interest
  o Author C declares there he has no conflicts of interest
  o Author D declares there he has no conflicts of interest
- Ethical approval
- The article does not contain any studies with human participants or animals performed by any of the authors
- Informed consent
- Informed consent was obtained from all individual participants included in the study

Risk factors

SV-Rfistula is an extremely rare occurrence following low anterior resection for rectal cancer. Only 12 cases have ever been described in the literature [3-11]. As such there is no clear consensus to explain why they occur or which patients are at risk. Neo-adjuvant radiotherapy is routinely used to downstage rectal cancer prior to low anterior resection. This can be associated with a more challenging surgical dissection as tissue planes can be fibrosed as a result of radiotherapy and dissection at the level of the distal rectum and seminal vesicles can be extremely difficult.

Previously reported SV-Rfistulae invariably occurred after ‘low’ anterior resection. No fistulation has been reported following high anterior resection where distal dissection of tissues does not routinely extend to the level of the seminal vesicles. Several reports suggest...
Anastomotic dehiscence as a preceding event in the formation of SV-R fistula. Gaining access to a narrow male pelvis can be difficult. Safe and accurate dissection avoiding injury to the seminal vesicles and fascial planes can be challenging. Laparoscopic techniques may provide the surgeon with an improved view using angled laparoscopes and greater access low in a male pelvis. However laparoscopic access does not appear to be protective as SV-R fistulae is equally described in the literature in open and laparoscopic cases [3-11].

Iatrogenic injury either by enbloc seminal vesicle resection or inadvertent incorporation of the seminal vesicles during stapling at the time of anastomosis is also postulated as a potential risk factor [5]. In this single reported case the patient had malignant disease invading the seminal vesicles which were resected enbloc [5].

**Clinical Presentation**

On review of the literature it is widely accepted that fever and pneumaturia are the commonest presenting symptoms. Fever is described in 10 of 13 cases [4-7,9-12] and pneumaturia in 10 of 13 cases [3-6,8-11]. Fever is of course a very non-specific symptom whereas pneumaturia should be considered highly suggestive of fistulation between urinary tract and a newly formed low rectal anastomosis in any setting. Other presenting symptoms of urinary tract irritation or infection were also described such as frequency, dysuria and testicular pain or swelling. Presentation of symptoms is reported anywhere between post-operative day 5 to 53, however the majority of patients presented within the first 2 weeks post-operatively (Table 1).

**Investigation**

The most common investigation of choice for detection of SV-R fistulae is computed tomography. This was used to identify 11 of 13 cases [4-11] and would also be the best modality to identify evidence of anastomotic leak. Contrast studies such as water soluble contrast enema, fistulography, vasogram and irrigoscopy were also used in some cases. In order to confirm resolution or healing a water soluble contrast enema was found to be the most widely used imaging modality (Table 1).

**Management**

There are several options for the management of SV-R fistula, ranging from conservative measures to rather extensive surgical intervention. Conservative treatment with antibiotics only can be successful [5,6,8-10]. In four cases authors described catheterization of the bladder in order to reduce intra-vesical pressure and encourage healing. This was achieved trans-urethrally in three cases [5] and supra-pubically in one [6]. Four of the thirteen reported cases underwent de-functioning of the anastomosis using a proximal stoma; two via colostomy [4,5] and two via an ileostomy [7,11]. Seven cases reported successful resolution without stoma formation [3,5,6,8-10].

The earliest case of SV-R fistula was documented in 1989 by Goldman who described undertaking a cutaneous vasostomy in order to drain sepsis [3]. In this case clinical symptoms settled after a prolonged period however the patient then developed recurrence and died of metastatic disease. The use of cutaneous vasostomy is unlikely to be necessary and subsequently has not been used in any other cases. Nakajima reported SV-R fistulation in a patient with an extensive rectal cancer invading the seminal vesicles requiring enbloc excision [5]. Following failed conservative management, subsequent attempted fistula closure using initially a gracilis muscle flap followed by a rectus muscle flap was attempted both unsuccessfully. The patient eventually developed recurrence and underwent successful pelvic exenteration. Soda described fibrin glue administration directly into the fistula tract via colonscopy [8]. The authors describe resolution of fistula symptoms with no recurrence at six months. Other studies have also shown safe and effective use of endoscopic fistula management in the form of fibrin glue [12]. Time to resolution appears to take months as opposed to years although there is not consistent documentation of resolution of symptoms and radiological evidence of fistula closure [3-11].

It can be hypothesized that a de-functioning loop ileostomy is either protective in the development of seminal vesicle-rectal fistulae, or prevents the detection of the phenomena and masks symptoms prior to ileostomy closure and clinical sequelae.

**Aetiology**

The commonest explanation given in the literature for the sequence of events leading to SV-R fistula is anastomotic leak, small pelvic abscess followed by development of fistula. Exposure of the seminal vesicles following dissection at the level of Denonvilliers fascia and subsequent local sepsis also at this anatomical level is a logical theory to fistulae development [3-5,9]. This was described in 3 cases with radiological evidence of a leak (Figure 1).

Post-operative colitis has also been proposed as a hypotheses...
Disruption of anastomotic integrity identified on contrast enema is associated with subsequent SV-R fistulation (Figure 1). CT scan can be used to demonstrate fistulae between the neo-rectum, left seminal vesicle, prostate and urinary bladder (Figure 2 and 3). Abnormal flexible sigmoidoscopy should also alert the clinician to the possibility of SV-R fistulation and may be used to access the abnormal tract if fibrin glue is deployed as a treatment modality (Figure 3). A third-line treatment modality which is reported with poor success but may be considered includes a muscular rotational flap in combination with proximal diversion (Figure 4).

**Author Contributions**

Study conception and design: Mark Katory.

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Analysis and interpretation of data: Mark Katory, Steven Dixon, Iain JD McCallum, Chris Dennison.

Writing manuscript: Steven Dixon, Iain JD McCallum, Mark Katory.

**References**

1. American Cancer Society.