Use of a tissue expander to protect small bowel during radiotherapy in a bowel obstruction rises rapidly at doses greater than 60 Gy, and reaches small bowel can tolerate radiation doses to 30 Gy; the risk of small bowel toxicity is 100% at doses greater than 70 Gy (Berek and Hacker, 2009). Patients with inflammatory bowel disease are at an even greater risk of acute and chronic radiation-induced injury, with one study finding an overall incidence of severe enteric toxicity at 46% (Willett et al., 2000). Here we describe the case of a patient with cervical cancer and severe inflammatory bowel disease, in whom a saline-filled tissue expander was placed prior to radiotherapy with the goal of removing the small bowel from the radiation field.

2. Case

A 40-year-old woman presented to her family doctor with a one month history of abnormal vaginal bleeding and pelvic pain. Her medical history was significant for a 24-year history of Crohn’s disease which had been managed surgically as she could not tolerate her medications for various reasons. Over a period of 12 years she had undergone 11 segmental resections. Fourteen years prior to consultation, she had a bowel resection with incidental right salpingo-oophorectomy and subtotal hysterectomy, ostensibly because of adhesions between the bowel and uterus and adnexa. At the time the patient presented to her family doctor, she had not had a Pap smear for fourteen years, as she was not aware that she still had a cervix.

A Pap smear was performed and cytology showed a high-grade squamous intraepithelial lesion (HSIL). On colposcopy, an endocervical curettage also showed HSIL, and a biopsy taken in a loop electrosurgical excision procedure showed extensive poorly-differentiated squamous cell carcinoma. A bimanual exam revealed a 5–6 cm mass palpable in the upper vagina.

On MRI, a 5-cm mass was seen infiltrating the remnant of the cervix, with extension into the parametria and proximal half of the vagina (FIGO Stage IIB). Enlarged, irregular pelvic lymph nodes were seen, although it was unclear whether these were related to her malignancy or Crohn’s disease. A PET scan showed intense radiotracer in the cervical malignancy with multiple metabolically active parailiac lymph nodes bilaterally, consistent with nodal metastases. Both small and large bowels were FDG-avid.

The size of the malignancy and the suspicious pelvic lymph nodes made this patient a candidate for radical radiotherapy with cisplatin chemotherapy; however, there was concern that her Crohn’s disease would be aggravated with radiation.
### Table 1
Examples in the Literature of Pelvic Prosthesis Insertion in Order to Prevent Radiation Enterotoxicity.

| Author and year | Number of patients | Indication | Tissue expander (TE) filled to: (cm³) | Mesh | Radiation enteritis | Complications due to prosthesis |
|-----------------|--------------------|------------|--------------------------------------|------|--------------------|---------------------------------|
| Sugarbaker 1983| 1                  | Unspecified | 1000                                 | Prosthetic mesh | none               | none                            |
| Lasser 1986     | 9                  | Rectal cancer | ?                                   | Prosthetic mesh | none               | none                            |
| Cuttat 1991     | 4                  | Rectal cancer | 500                                 | ?    | none               | none                            |
| Herbert 1993    | 14                 | Endometrial, colorectal, anal cancer | 450–850               | none            | Statistical decrease in enteritis in patients with TE placement (compared to 63 patients not receiving TE) | Ileus (n = 1), Bowel perforation after removal of TE (n = 2), Perineal dehiscence in patient with transvaginal placement of TE in pelvic exenteration (n = 1) |
| Delaloye 1994   | 18                 | Cervical cancer | 350–400                            | Vicryl mesh | none               | Constipation (n = 1), Abcess (n = 4), Fistula (n = 4), TE extrusion (n = 1), TE deflation (n = 3), Heaviness (n = 1), Flank pain (n = 2) |
| Hoffman 1998    | 58                 | Sarcomas; endometrial, vaginal, cervical, rectal, colon, anal cancer | 450–1500              | none            | none               | Bowel injury during positioning of tissue expander (n = 1), Adhesions of bowel to implant (n = 1), Hydronephrosis (n = 1) |
| Sezuer 1999     | 22                 | Retroperitoneal sarcoma, pelvic cancer | 600                                 | Vicryl mesh | none               | Pelvic Ewing's sarcoma (n = 1), Migration implant (n = 1), Vesicovaginal fistula (n = 1), Enterocutaneous fistula (n = 1), Rectovaginal fistula (n = 1) |
| Burnett 2000    | 7                  | Cervical cancer | 960–1200                            | none            | none               | None                            |
| Abhyankar 2005  | 1                  | Retroperitoneal rhabdomyosarcoma | 250                                 | Vicryl mesh | none               | None                            |
| Holmnbakk 2006  | 1                  | Retroperitoneal recurrence of colorectal cancer | 500                                 | Vicryl mesh | none               | None                            |
| White 2007      | 33                 | Sarcomas, endometrial, vaginal, colon, rectal cancer | 700                                 | Dexon mesh | none               | None                            |
| Angster 2010    | 2                  | Cervical cancer, retroperitoneal sarcoma | 400–500                            | none            | none               | None                            |
| Geller 2009     | 10                 | Cervical cancer | 720                                 | none            | none               | None                            |
| McKay 2011      | 1                  | Prostate cancer | 350                                 | none            | none               | None                            |
| Valle 2011      | 28                 | Cervical cancer | ?                                   | none            | none               | None                            |
| Perez-Munoz, 2014 | 20            | Pelvic Ewing's sarcoma | ~500                               | none            | none               | None                            |
| Geller 2009     | 10                 | Cervical cancer | 720                                 | none            | none               | None                            |
| McKay 2011      | 1                  | Prostate cancer | 350                                 | none            | none               | None                            |
| Valle 2011      | 28                 | Cervical cancer | ?                                   | none            | none               | None                            |
| Perez-Munoz, 2014 | 20            | Pelvic Ewing's sarcoma | ~500                               | none            | none               | None                            |
A new protocol of neoadjuvant chemotherapy (cisplatin and taxol weekly for six weeks) was offered, with the intention of shrinking the tumor. If adequate shrinkage of the tumor resulted, laparotomy with pelvic node dissection and radical trachelectomy could be performed. A tissue expander would be placed in the pelvis in order to move the bowel out of the radiation field. After surgery, we planned to administer external beam radiotherapy.

An MRI performed on completion of the neoadjuvant chemotherapy showed significant shrinkage of the lesion, but it appeared to be very close (if not infiltrating) to the rectum. Trachelectomy with colostomy was proposed, but the patient refused to consent to colostomy. Therefore only laparotomy with pelvic lymphadenectomy was performed. At this time, a tissue expander (filled with 600 cm³ of normal saline) was inserted into the pelvis, and a Vicryl mesh hammock was placed to prevent the small bowel from sliding down around the expander. Pathology resulted showing two of nine pelvic lymph nodes being positive for metastatic squamous cell carcinoma.

External beam radiotherapy using an intensity modulated technique was started 17 days after pelvic lymph node dissection and placement of the tissue expander. A dose of 45 Gy was delivered in 25 fractions over five weeks to a volume containing the primary cancer, upper vagina, paracervical tissues and lymph node areas at risk. Cis-platin 30 mg/m² was given weekly during this treatment. A boost dose of 20 Gy in ten fractions over two weeks was then delivered to the cervical stump. Interstitial brachytherapy was not used as it would not have been possible to encompass the entire cervical stump in the high dose volume that can be achieved with interstitial needles without puncturing the prosthesis.

During the five weeks of radiotherapy, the patient developed bilateral deep vein thromboses, a small pulmonary embolism, and a right renal vein thrombosis, requiring the placement of an inferior vena cava filter. She had severe pain and edema in both legs; it was unclear whether this was secondary to her thromboses or the tissue expander. At the completion of radiotherapy, she underwent laparotomy to remove the tissue expander and, on examination under anesthesia prior to laparotomy, a very small, low rectovaginal fistula was seen. It was distal to the lower edge of the radiation field and thought to be a pre-existing, previously undiagnosed consequence of her Crohn’s disease. It may explain the patient’s history of occasional incontinence when her stools were loose. The fistula spontaneously resolved shortly after. The patient has not developed any symptoms of radiation enteritis to date, and approximately eight months after removal of the tissue expander, she is well with no recurrence of her cervical malignancy.

3. Comment

In 1983, Sugarbaker was the first to describe insertion of a silicone breast implant into the pelvis, with a small bowel suspended above the radiation field by a prosthetic mesh sling (Sugarbaker, 1983). To our knowledge, there have been more than 200 cases since 1983 describing insertion of tissue expanders (TEs) into the pelvis to protect the small bowel from radiation. These cases include gynecologic malignancies, colorectal and prostate cancers, and abdominal sarcomas.

The benefit of TEs includes easy insertion and removal, lack of adherence to bowel or peritoneum, resistance to degradation by radiation, and being similar in density to human tissue, thereby not altering dose distribution of radiation (McKay et al., 2011). However, radiation cystitis and proctitis remain common, as the TE does not protect the urinary bladder, ureters, or rectum. In addition, the TE exerts a mass effect on surrounding structures (colon, ureters, urinary bladder, iliac vessels), which may lead to thromboembolism (Burnett et al., 2000), a sensation of heaviness (Sezeur et al., 1999), hydronephrosis and constipation (Delaloye et al., 1994). These risks increase with the size of the TE (McKay et al., 2011).

It is difficult to deduce what role the TE may have played in our patient developing multiple thromboembolisms, since malignancy, Crohn’s disease, chemotherapy, and radiotherapy all increase the risk of thromboembolic events. On reviewing the literature, TE volumes between 250 and 1500 cm³ have been reported; only one study (7) reported a thromboembolic event, while using volumes between 960 and 1200 cm³ (Table 1). While the tissue expander we used was no larger than many ovarian masses, and by no means tightly wedged in the pelvis, we would consider using a smaller TE volume in the future.

In the largest published study (Hoffman et al., 1998) of TE placement to date, Hoffman et al. describe enterocutaneous fistula development in four of 58 patients; three patients developed fistulae after TE removal, and one prior to removal. Two of these fistulae (one pre-TE removal, one post-) were associated with abscesses that had formed around the TE. Geller et al. (Geller et al., 2009) describes three of ten patients developing fistulae: the first, a vesicovaginal fistula that formed while the TE was in situ, the second a rectovaginal fistula eighteen months after removal of the TE, and the third an enterocutaneous fistula associated with an abscess while the TE was in situ. Our patient was found to have a tiny rectovaginal fistula prior to the period of radiotherapy; however, this formed outside of the radiation field, and healed spontaneously shortly thereafter. As per Hoffman’s study, the incidence of infection, abscess formation, and fistulization with tissue expander placement are 7% (Hoffman et al., 1998). However, we believe this fistula pre-dated the placement of the tissue expander, and was secondary to her Crohn’s disease.

We elected to place both a tissue expander with a Vicryl mesh hammock because of reports of TE migration and loops of the small bowel slipping down into the radiation field (Geller et al., 2009). Several studies (Sezeur et al., 1999; Delaloye et al., 1994) have described the concomitant use of a Vicryl mesh hammock with a TE. Of eighteen patients described by Sezeur et al. (Delaloye et al., 1994), one experienced constipation and the other transient bilateral hydronephrosis. Of twenty-two patients described by Sezeur et al. (Sezeur et al., 1999), two experienced flank pain (necessitating deflation of the TE between radiation sessions), and one required the TE to be removed because of an infection secondary to an injury to the bowel caused during TE positioning. Some authors (Dasmahapatra and Swaminathan, 1991; Rodier et al., 1991) have described the use of a Vicryl mesh alone, however the drawback to this method is that mesh degrades approximately one month after placement, necessitating early radiotherapy. This is not always possible, especially in patients with a complicated postoperative course (Sezeur et al., 1999).

To our knowledge, this is the first description of a case in which a tissue expander was placed to reduce the risk of radiation enteritis in a patient with inflammatory bowel disease. The overall complication rate associated with TE placement has been estimated to range between 5 and 40% (Geller et al., 2009) based on major prospective trials. Given the risks of TE, this therapeutic strategy can be considered for patients at a high risk for radiation toxicity as illustrated in this patient with multiple prior surgeries and inflammatory bowel disease.

4. Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

Conflict of interest statement

The authors have no conflicts of interest to report.

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