Use of Saline-Filled Tissue Expanders to Protect the Small Bowel from Radiation

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Over the past 7 years, 58 saline-filled tissues expanders (TEs) have been temporarily placed in 57 patients. The

Introduction

Small bowel sensitivity to ionizing radiation remains an impediment to adequate radiation therapy (RT) for some primary and most recurrent abdominal and pelvic cancers. This is particularly true for patients who have undergone prior surgery, in whom the small bowel is usually tethered by adhesions into the treatment fields.[1-3] Even with the most modern surgical and RT techniques, there is a 5% to 7% chance of severe early or late radiation toxicity to the small bowel (obstruction, perforation, or bleeding) from RT for primary rectal cancer.[4]

The risk of major small bowel toxicity is greatly increased in patients with recurrent tumors, who have usually received prior RT and surgery. In such cases, some method of small bowel exclusion from the radiation treatment fields must be performed at the time of surgery if further RT is to be delivered. Unfortunately, most of these patients have insufficient residual omentum for exclusion of the small bowel from radiation fields.[5,6]

Over the past 15 years, various techniques and foreign materials for small bowel exclusion have been described.[7-14] Unfortunately, there have been no prospective trials comparing the different options, nor have there been large, prospective experiences with any one method.

We first used a saline-filled tissue expander (TE) for small bowel exclusion in 1989 and reported our experience with the first 34 of these expanders in 1994.[15] This article now updates our experience to include 58 TEs placed in 57 consecutive patients.

Materials and Methods

The indications for the placement of TEs were: small bowel exclusion from external-beam RT (N = 25), interstitial RT (N = 16), or both (N = 13) when there was insufficient omentum to provide adequate exclusion (4 expanders were withdrawn without RT). Of the 57 patients, 24 patients had primary tumors (4 colon, 4 endometrial, and 11 rectal cancers; 3 sarcomas; 1 schwannoma; and 1 vaginal cancer). The remaining 33 patients (58%) had recurrent cancers (3 anal, 8 colon, and 16 rectal cancers; and 6 sarcomas); 26 (79%) of these patients had received prior RT. Of the 58 expanders, 15 were placed superior to the iliac vessels and 43 were placed in the pelvis (Table 1).

In only one case was the TE placed as the sole purpose of the operation. All other placements were associated with major abdominal or abdominopelvic procedures (Table 2). Bowel, vascular, ureteral, and biliary anastomoses were often beside or beneath the TE. The methods of TE placement and removal have been described previously.[15] The last 17 consecutive TEs placed were custom-made devices (C.U.I. Corporation, Carpinteria, California) with rapid-fill ports and sewing straps to facilitate preparation and placement (Figure 1). A suture of 3-0 chromic was used for the sewing strap, so that it can easily be broken at TE withdrawal. All of the expanders were filled with sterile saline, and most were also filled with 10 mL of iodinated contrast material, which allows for viewing of the filled prosthesis by plain radiograph. Omentum, when available, was placed beneath the TE. Either a small bowel series or computed tomography (CT) was used to demonstrate small bowel exclusion prior to external-beam radiation or brachytherapy. The prostheses were removed, usually with the patient under general anesthesia, from 6 to 172 days (median, 85 days) after placement.

Results
The efficacy of small bowel displacement with these devices has already been demonstrated.[15,16] Complications have included early withdrawal (N = 5), infection contiguous with the TE (N = 5), TE deflation (N = 3), and small bowel fistulae after (N = 3) or before (N = 1) TE withdrawal. Of the four cases of small bowel fistulae, two (one prewithdrawal, one post-withdrawal) were associated with abscesses around the expander and two occurred in patients without infection around the TE (Table 3). One patient developed infection and also required early withdrawal of the TE. Of the eight patients in whom the expander deflated or was associated with an infection, only one received less than the intended radiation dose.

Five TEs were removed earlier than planned: one because of infection around the pelvic TE, one because of perineal TE extrusion, one because of an unrelated postoperative small bowel obstruction and a change in plans for postoperative radiation, and two because of missed diagnoses at the time of surgery. One missed diagnosis was a recurrent rectal cancer after prior radiotherapy that was thought to be deeply infiltrating at the time of re-resection. However, the tumor actually was completely intramural, and lymph nodes were not involved. In the other case, a pelvic soft-tissue tumor was diagnosed as a schwannoma after removal.

Two other mishaps were associated with TE placement. One patient with a 600-mL expander placed into the lumbar fossa was noted upon withdrawal of the device to have erosion of the fill-port catheter into a loop of small bowel. This was repaired without incident. Another patient with a total pelvic exenteration had a residual fluid-filled cavity after TE withdrawal, which prompted placement of a suprapubic catheter by a physician who mistakenly thought the cavity to be a bladder.

**Discussion**

This experience with saline-filled tissue expanders as a method for small bowel exclusion has resulted in the development of a custom prosthesis that is easy to use, consistently resists deflation, and effectively excludes small bowel from radiotherapeutic fields. There has probably been a learning curve associated with the technique of removing the expanders, as no withdrawal-related small bowel fistulae have been seen after a surgeon has removed at least 10 TEs. It cannot be overemphasized that the wound for TE removal should be large enough for adequate exposure, general anaesthesia should be used, and minimal force should be applied in a direction away from the adjacent bowel during extraction of the deflated TE.[15]

The dead space remaining after TE removal is a theoretical problem if it were to become infected or to connect to a sinus exiting through the skin. We have followed 18 patients with either drains or sinuses connected to the TE capsule, and none has developed chronically draining sinuses or subsequent abscesses. If an infected space or a space connected to a cutaneous sinus is encountered at the time of TE removal, the space should be drained and an attempt should be made to close the space by liberating surrounding bowel adhesions or omentum.

The indications for TE placement as a method of small bowel exclusion, as opposed to other foreign bodies or tissue rearrangements (such as rectus abdominis or gracilis myocutaneous flaps), have not been established by phase III trials. Tissue expanders are probably slightly more expensive than polyglactin or polyglycolic acid meshes, but they last longer (the mesh is gone in 3 to 4 months), are easier to place and withdraw, and have a proven record of adequate exclusion. Also, if exposed to infection, TEs can usually be drained and treated more easily than meshes without curtailing RT. If adequate small bowel exclusion can be accomplished by native tissue, such as an omental plug or sling or a fibroid uterus, this certainly should be the exclusion method of choice. Unfortunately, patients who have the greatest need for small bowel exclusion (eg, those who have undergone prior surgery and RT) are the least likely to have native tissue available for exclusion. In such cases, we have found saline-filled TEs to be the most reliable method for small bowel exclusion.

**References:**


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