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Proficiency-based cervical cancer brachytherapy training

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ABSTRACT

PURPOSE: Although brachytherapy increases the local control rate for cervical cancer, there has been a progressive decline in its use. Furthermore, the training among residency programs for gynecologic brachytherapy varies considerably, with some residents receiving little to no training. This trend is especially concerning given the association between poor applicator placement and decline in local control. Considering the success of proficiency-based training in other procedural specialties, we developed and implemented a proficiency-based cervical brachytherapy training curriculum for our residents.

METHODS AND MATERIALS: Each resident placed tandem and ovoid applicators with attending guidance and again alone 2 weeks later using a pelvic model that was modified to allow for cervical brachytherapy. Plain films were taken of the pelvic model, and applicator placement quality was evaluated. Other evaluated metrics included retention of key procedural details, the time taken for each procedure and presession and postsession surveys to assess confidence.

RESULTS: During the initial session, residents on average met 4.5 of 5 placement criteria, which improved to 5 the second session. On average, residents were able to remember 7.6 of the 8 key procedural steps. Execution time decreased by an average of 10.5%. Resident confidence with the procedure improved dramatically, from 2.6 to 4.6 of 5. Residents who had previously never performed a tandem and ovoid procedure showed greater improvements in these criteria than those who had. All residents strongly agreed that the training was helpful and wanted to participate again the following year.

CONCLUSIONS: Residents participating in this simulation training had measurable improvements in the time to perform the procedure, applicator placement quality, and confidence. This curriculum is easy to implement and is of great value for training residents, and would be particularly beneficial in programs with low volume of cervical brachytherapy cases. Simulation programs could also be created for other technically challenging radiation oncology procedures.

Keywords: Cervical cancer; Brachytherapy; Resident education

Introduction

Gynecologic brachytherapy is an essential component in the curative treatment of cervical cancer. Doses to the cervix in the range of 80−90 Gy are associated with the highest rates of local control and overall survival (1, 2). Intracavitary brachytherapy remains the best method to spare normal tissues from late radiation toxicities (3). However, a recent Surveillance, Epidemiology, and End Results analysis has shown that brachytherapy utilization rates in cervical cancer have decreased from 83% in 1988 to 58% in 2009 ($p < 0.001$) (4). Although reasons for the decline in use of brachytherapy are multifactorial, physician comfort with procedural techniques is likely a contributing cause.

It is well documented in the surgical literature that surgical volumes improve outcomes. Since the hallmark 1979 study noting this correlation, a plethora of studies have been published on this same effect observed across various procedural techniques (5). In cervical brachytherapy, a study examining 55 facilities by volume of cancer treated revealed that smaller facilities were significantly more likely to deliver suboptimal treatment, including a total dose to Point A of <80 Gy (6). Although source delivery

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optimization is feasible in high−dose rate brachytherapy, it is unable to compensate for improper applicator positioning, which has been linked to poorer outcomes. Viswanathan *et al*. examined the brachytherapy implant quality in patients treated in Radiation Therapy Oncology Group 0116 and 0128 and determined that local recurrence and disease-free survival were significantly impacted by inferior applicator placement (7). In addition, rates of complications with this procedure decrease with increased confidence and procedural skill of the practitioner. Particularly, rates of uterine perforation and vaginal laceration decrease as the brachytherapist gains confidence using ultrasound guidance for tandem placement (8, 9).

Simulation training has played a crucial role in medical education, demonstrating improved performance and knowledge in skills ranging from cardiopulmonary resuscitation to laparoscopic cholecystectomies (10−12), but remains underutilized in radiation oncology. An extensive literature search on brachytherapy training revealed a few prostate education models, but none for gynecologic brachytherapy (13, 14). In fact, the only gynecologic brachytherapy training publications have focused on the creation of reasonable phantom models as there are no commercial ones available (15−17). Conversely, there are many advanced equipment and software options for the training of surgical and other procedural techniques. For example, most medical students and surgical residents have access to virtual reality simulators for laparoscopic skills training. A randomized trial showed that surgical residents receiving this high-fidelity training before a laparoscopic cholecystectomy made significantly fewer errors (12). Another trial with anesthesia residents randomized to either simulation-based training or an interactive seminar on cardiopulmonary bypass weaning showed that the simulation group performed much better on tests both 2 and 5 weeks later (18).

Long-term retention is a major benefit in radiation oncology, where residency is typically structured around disease-specific site rotations with each resident participating in only one to two gynecologic radiation oncology blocks. We hypothesized that residents would benefit from a proficiency-based cervical brachytherapy curriculum in regards to procedural technique, information retention, and confidence. We thus developed and implemented a proficiency-based cervical brachytherapy simulation curriculum with outcome assessments.

Methods and materials

Several manufacturers offer pelvic models for gynecologic exam education. From funding provided by the American College of Radiation Oncology resident education grant, we purchased a pelvic model and various cervices representing different disease states (available at http://www.gaumard.com/s503) and modified it by creating a cervical os to permit tandem and ovoid brachytherapy. We also created a bladder by using a firm water balloon filled with contrast attached to a rectal tube simulating a urethra, allowing for Foley catheter insertion.

Eight radiation oncology residents, including two postgraduate year (PGY) 2, three PGY 3, one PGY 4, and two PGY 5, participated in the curriculum. Residents were informed of the steps before the initial session, which are per the American Brachytherapy Society consensus guidelines procedural checklist (7), including first being able to adequately stage the tumor using the vaginal and rectovaginal exam, inserting the urinary catheter with 7cc of contrast placed in the Foley balloon and the rectal tube with contrast, sounding the uterus, inserting the tandem followed by the ovoids, visually ensuring symmetric placement and inserting the packing material. For the first brachytherapy training session, each resident placed tandem and ovoid applicators using our pelvic model under the guidance of a gynecology attending physician. Two weeks later, residents performed the procedure by themselves (with an assistant to retract) without the supervision of the attending (Fig. 1). The resident then placed the pelvic model with brachytherapy applicator in place onto a brachytherapy board (Fig. 2). Initially CT simulation was planned, but proved too labor and time intensive for the purpose of this workshop. Therefore, for each implant anteroposterior and lateral x-rays of the pelvic model were taken.

Five criteria were evaluated (Table 1), including symmetry of the ovoids in relation to the tandem, displacement of the ovoids with respect to the cervical os, position of the tandem in the midpelvis on lateral film, bisection of the ovoids by the tandem on lateral film, and appropriateness of packing (Fig. 3). The importance of these criteria was discussed during an introduction before the initial session. Each criterion was scored by other residents, a PhD brachytherapy physicist, and an attending gynecologic radiation oncologist as 0 if unsatisfactory or 1 if satisfactory, with a maximum score of 5 available. As an objective measure that the necessary steps were performed, a checklist of the key procedural steps was used (Table 2), which included insertion of rectal contrast, insertion of Foley catheter with 7cc contrast in balloon, sounding of the uterus with accurate measurements, correct placement of the tandem and two ovoids, visual evaluation of the applicator placement, and insertion of vaginal packing. The times taken for the first and second procedures were also recorded. Residents had the opportunity to review the scans and scoring criteria, providing direct feedback. The same steps were repeated the following week, and the two scores were compared. All residents filled out a pretraining and post-training survey to assess confidence in performing the procedure (Table 3).

Although we did not incorporate CT simulation as part of our training session, it could easily be performed, allowing for contouring and dosimetric planning. Figure 4 shows an example of images obtained of the pelvic model on our CT simulator and uploaded into our commercial brachytherapy planning system.