The authors’ institution utilises ultrasound technology in a number of radiotherapy treatments. Ultrasound enables visualisation of organs and applicator positioning in brachytherapy treatments, ensuring safe and accurate treatment without the associated risk of concomitant radiation exposure. Barbara Segedin et al concluded: “Ultrasound guidance of applicator insertion is useful and feasible, allowing the completion of the planned treatment even in challenging cases.”

A prime example of the use of ultrasound equipment is the treatment of prostate cancer using high dose rate (HDR) brachytherapy and as van Dyk et al observed: “Although use of ultrasound is the standard of care in brachytherapy for prostate cancer, it only seems to have limited uptake in gynaecologic brachytherapy.” That is now changing, with the use of ultrasound in several areas of brachytherapy improving service to the patient and, ultimately, the outcome.

Prostate

Prior to the HDR treatment the patient is given an enema. On the day of treatment the patient undergoes a general anaesthetic. Their legs are placed into the lithotomy position and, once prepared, the ultrasound probe is introduced into the rectum. The HDR needles are then introduced into the prostate, through a grid, the needles entering the prostate via the perineum. The needles are placed into the peripheral position of the prostate and then in the central area avoiding the urethra.

Ultrasound (BK Medical Pro Focus Green at this institution) allows guidance of the needles, and if there is a lot of swelling or movement, they can be re-sited in real time. The prostate is outlined on the ultrasound slices and the dose is optimised to comply with the dose constraints of the organs at risk, in addition to aiming for the optimal dose to the target. As noted by Cunha et al: “Alternative catheter patterns may decrease toxicity by avoidance of the critical structures near the penile bulb while still fulfilling the RTOG criteria.” Once optimisation is complete the dwell times for each needle are calculated and the HDR treatment is delivered via an Elekta Flexitron HDR machine.

The use of ultrasound enables delivery of the treatment in situ, without the need to move the patient for further verification imaging, therefore limiting the possibility of movement and making the procedure quicker. This in turn limits the time the patient is anaesthetised and thus reduces the recovery time. Unless the patient suffers any complications they will leave the hospital on the same day. Currently the prostate ultrasound is performed by the consultant urologist.

Cervix

Ultrasound can also be used for visualising the insertion of applicators for cervix cancer. In the case of gynaecological patients the therapy radiographers (after training and the achievement of competencies) are able to perform ultrasound using a curved array transducer, for the imaging of HDR brachytherapy. While the oncologist is placing the applicators, particularly the intrauterine tube, the ultrasound images are used to track the progress of the tube as it travels through the cervix and into the uterus. Accurate guidance ensures that perforation or ‘tenting’ of the uterus is prevented. Tenting can occur due to the length of the uterus being measured with a gynaecological sound, while legs are in the lithotomy position. However, once the legs are brought down to rest on the bed, the intrauterine tube can move superiorly; in some cases this can be as much as 0.5cm. This tenting can lead to perforation. Koukourakis et al indicate that ultrasound of the uterine cavity prior to the insertion of the brachytherapy intrauterine applicator was of paramount importance to prevent unwanted complications. Sharma et al also found that the use of ultrasound guided the accurate placement of brachytherapy applicators, avoiding injury to the normal pelvic structures. Mayr et al have additionally suggested advantages to using ultrasound in the brachytherapy applicator placement of patients with an ante-verted uterus, which can offer acceptable results for a population of patients that can have difficult anatomy due, in part, to the tumour.

Endometrium

For other gynaecological cancers, such as endometrial tumours, ultrasound can provide images that enable the correct placement of vaginal vault applicators. This can be achieved by CT scanning but, with the use of ultrasound imaging, optimal images can be attained without the need to move the patient, negating the possibility of applicator movement, in a timely manner.

Van Dyk et al stated: “Improved technical quality and accuracy have been shown to improve local control of disease.” And: “Additionally to its use for applicator positioning for the gynaecological patient transabdominal ultrasound also offers an accurate, quick, accessible and cost-effective method of conformal brachytherapy planning.”

Skin

The application of ultrasound imaging in the treatment of skin lesions has growth potential. Using a straight transducer to measure the depth of skin tumours, the clinician can obtain valuable additional information about the thickness of a lesion. This in turn enables the clinician to optimise skin treatment by informing the choice of treatment.
modality and energy when prescribing.

Ballester-Sánchez et al undertook a study to use ultrasound to determine the depth of basal cell carcinomas, in order to minimise the depth of surgery and to avoid unnecessary irradiation. They concluded there was an accurate determination of the lesion depth which was comparable to, and as accurate as, clinical examination and biopsy.

The use of high frequency ultrasonography between 10MHz and 50MHz has made it possible to visualise deep layers of skin, and to define very small hypo-echoic masses.

### Training

Ultrasound training is provided by a range of higher education institutions, however this institution utilised the training delivered by the University of the West of England, Bristol. The course was aimed at non-sonographers being trained in the limited use of ultrasound for specific clinical activity. It was conducted over two days covering an introduction to diagnostic ultrasound and ultrasound guided brachytherapy. Practical training was given by a superintendent radiographer in ultrasound and the sonography team. This training was complemented by the addition of a competency portfolio, enabling staff to demonstrate the skills and competence to use the equipment safely and effectively. Training is endorsed through an Expansion of Practice authorisation granted by the employing trust.

According to van Dyk et al: “Training is limited in scope to meet a specific purpose. By focusing on these aspects, a very particular set of skills can be learnt in a short period of time. The high interoperator reliability was also based on good existing anatomical and applicator knowledge.”

### Service development

Ultrasound can be utilised to benefit patient pathways in varying ways including, for this institution, the use of ultrasound outside of brachytherapy as well. Pre-CT bladder ultrasounds would enable radiographers to identify patients who are non-compliant with bladder filling protocols and advise patients accordingly, without the use of radiation.

### Conclusion

Although the training required is limited and the use of ultrasound restricted to specific sites, the benefits to the organisation through efficiency savings and to the patient through improved treatment accuracy are significant. In the author’s opinion ultrasound should be standard imaging in the brachytherapy pathway and it will increasingly be used in all institutions.

### References


### Bibliography