Transrectal ultrasound guided prostate brachytherapy
Prostate Brachytherapy is an effective treatment for localized prostate cancer with high patient tolerability and acceptable morbidity outcome data. It is a technique that delivers a high dose of radiation to a small target volume of tissue, minimizing radiation side-effects to adjacent structures.

Brachytherapy of the prostate can be delivered in two different ways: permanent seed implants using iodine or palladium seeds (Low Dose Rate, or LDR) or using temporary removable implants with iridium wires (High Dose Rate, or HDR). Biplane transrectal ultrasound is essential for accurate imaging guidance to place the radioactive sources into the prostate using a template guided transperineal technique.

Prostate brachytherapy is a valid alternative to radical prostatectomy and external beam radiotherapy for localized prostate cancer.

The exact choice of brachytherapy technique will vary depending on the stage of the prostate cancer and disease-specific parameters such as the Serum PSA at presentation and the Gleason Score from the prostate biopsy. LDR Brachytherapy is performed with permanent implantation of radioactive “seeds” into the prostate, usually Iodine-125 with a half life of 60 days, although Palladium sources can also be used. HDR Brachytherapy uses temporary placement of iridium wires into the prostate, and these are then removed after the treatment is completed. Whatever technique is used, the transrectal ultrasound procedure is similar: the prostate is scanned to obtain an accurate volume and shape and this information is used by the radiation planning software to generate a 3-dimensional dose plan for each patient. The ultrasound data collected from this pre-treatment volumetric assessment, or Prostate Volume Study, is the basis for calculating the required number and location of sources for that particular patient and consists of both prostate volume acquisition and accurate 3-D volume rendered dosimetry. The radioactive sources are then inserted, transperineally, into the gland using a template-guided technique under real-time biplane ultrasound guidance, of which the B-K Medical 8848 biplane transducer together with the Pro Focus scanner are ideally suited.

Many brachytherapy variations have been
developed since the original description of the Seattle 2-stage technique, including various interactive implant techniques using real time ultrasound based dosimetry. However, transrectal ultrasound is the basis for all technique variations and similar principles apply.

**Transrectal ultrasound set-up**

The procedure is performed in the operating room with the patient in the dorsal lithotomy position. General anaesthesia is generally used although, occasionally, spinal anaesthesia may be utilized. An inflatable stand-off can be used with the 8848 biplane transducer to permit elevation of the gland, if necessary, in order to obtain optimum access for needle positioning. The transducer is mounted in a stepping device that allows the prostate to be scanned systematically from base to apex using either sequential 5mm axial sections or a sagittal volume-based scanning technique. The bladder may be catheterised and radiographic contrast can be introduced into the bladder to facilitate fluoroscopy of the bladder base. Aerated ultrasound gel can also be used to delineate the urethra. An implant grid, mounted onto the stepping unit, is placed against the perineum to guide needle and source placement within the prostate. This implant grid is calibrated to an on-screen superimposition of the grid matrix over the ultrasound image.

Advanced software in the B-K Medical Pro Focus scanner permits very accurate volume and surface outline calculations of the prostate and seminal vesicles. Pro Focus software also includes a matrix offset which can be programmed to compensate for any non-standard matrix and the 8848 transducer can be used for seed implantation with a choice of specially designed brachytherapy matrix templates.

Using the ultrasound data, the requisite number and distribution of radioactive sources is calculated for the patient. The Urology Pro package with the Pro Focus scanner contains all the essential setups and measurements for precise volume studies, simultaneous biplane imaging and tissue harmonic imaging. Biplane ultrasound with the 8848 transducer allows each needle to be monitored as it is inserted transperineally into the prostate. The sources are then loaded into the prostate, through these needles, under direct, real-time ultrasound guidance. Great care
must be taken to avoid inadvertent trauma to the bladder, urethra and rectum during insertion. The procedure may utilize either the calculated pre-plan or newer intra-operative techniques now being developed which require continuous updating of the dose plan using feedback from ultrasound-based seed dosimetry. Biplane ultrasound with the 8848 greatly facilitates identification of needle and source deposition in the prostate and enhances the development of these newer implantation modifications. When the implant has been concluded, the prostate may be re-scanned to verify seed location for Low-Dose implants. For High-Dose implants, re-scanning may be used to ensure no source displacement prior to subsequent treatments depending on the radiation dose fractionation protocol used.

- Morbidity

Most patients will experience some urinary symptoms after prostate brachytherapy and acute urinary retention generally occurs in about 15% of patients following LDR brachytherapy. Nocturia and daytime frequency are very common, and overall urinary morbidity does correlate with higher pre-treatment International Prostate Symptom Score (IPSS) urinary scores. The relationship between urethral dose and urinary toxicity is unclear, although most patients benefit from routine use of alpha blockers (smooth muscle relaxants) during the initial weeks after implantation. Prolonged urinary catheterisation is unusual and surgery to improve urinary flow should be avoided, if at all possible, as it has a high risk of causing incontinence afterwards.

Rectal complications are uncommon and usually consist of self-limited proctitis. Long-term bowel dysfunction after brachytherapy is very unusual.

Preservation of sexual function after brachytherapy, as with other prostate cancer treatments, is difficult to assess. The only study using a validated quality of life scoring system reported that 6 years after prostate brachytherapy was used as monotherapy, 52% of the study’s subjects maintained erectile function.

- Biochemical Control

The development of prostate brachytherapy as an alternative to radical surgery and external beam radiotherapy has generated considerable clinical interest into its value and on clinical outcomes.
Prostate brachytherapy data has now matured as a treatment with consistent results reported from major centers in the US and Europe.

**Conclusion**

Prostate brachytherapy has become a widely accepted and valid method for the treatment of localized prostate cancer. Biplane transrectal ultrasound guidance, enabled by the B-K Medical 8848 transducer and the Pro Focus scanner with its specially designed Pro Package software and fully integrated 3D capabilities, greatly assists the safety and accuracy of the procedure.
REFERENCES


With more than 30 years of commitment to ultrasound innovation, B-K Medical specializes in the development, manufacture and distribution of dedicated ultrasound solutions. B-K Medical headquarters are located near Copenhagen, Denmark and we have offices and distributors throughout the world.

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