CASE REPORT

Migration of a strand of four seeds in low-dose-rate brachytherapy

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SUMMARY

We report a case of stranded-seed migration (one strand of four seeds), via the prostatic venous plexus to the internal pudendal vein, in low-dose-rate (LDR) prostate brachytherapy. A 70-year-old man with low-risk prostate adenocarcinoma underwent transperineal permanent seed implantation. A total of 93 iodine-125 seeds were implanted (91 stranded seeds and 2 loose seeds). Immediate postimplantation fluoroscopic image and day 1 postimplantation CT scan indicated all implanted seeds to be within the vicinity of the prostate as planned. Day 30 pelvic X-ray and CT scan revealed migration of a strand of four seeds to the right pelvis (adjacent to ischial spine). At 2 years postimplantation, the patient continues to have good disease control with prostate specific antigen level of 0.69 µg/L, and asymptomatic. To the best of our knowledge, this is the first report of migration of an entire strand of seeds following LDR prostate brachytherapy.

BACKGROUND

Low-dose-rate (LDR) brachytherapy with transperineal permanent seed implantation is a well-established approach in the treatment of low-risk prostate cancer. Seed migration is a known complication, with rates ranging from 0.7% to 55%.^{1–4} Seed migration can not only reduce radiation dose to the prostate and potentially compromise chance of disease control but also potentially cause injury at the site from where it has migrated.

In an attempt to reduce the incidence of seed migration, stranding of seeds onto absorbable vicryl sutures was introduced. Several studies have found that this approach is highly effective in minimising distant seed migration and embolisation events.^{1 2 5 6} In particular, it has been reported that there is a significant reduction in the incidence of pulmonary seed embolisation from 11% with loose seeds (LS) to 0.7% using stranded seeds (SS).² One series using SS reported no cases of pulmonary seed embolisation.⁵ Although early loss of SS through the urinary tract has been reported, the use of SS seems to have eliminated venous seed migration.⁷ To the best of our knowledge, venous migration of a whole strand of seeds has not been previously reported. In this case study, we report a case of SS migration (one strand of four seeds), via the prostatic venous plexus to the internal pudendal vein, in LDR prostate brachytherapy.

CASE PRESENTATION

The patient is a 70-year-old man with low-risk prostate adenocarcinoma (prostate-specific antigen

(PSA) 7.8 µg/L, clinical stage T1cN0M0 (National Comprehensive Cancer Network (NCCN) staging, Clinical Practice Guidelines in Oncology: Prostate Cancer. V4.2013), Gleason score of 3+3=6 in 2/27 core biopsies (left apex) and an unremarkable CT and bone scans). Transrectal ultrasound estimated the gland volume to be 34 cc. After discussing all possible treatment options, including conservative management, the patient chose to proceed with LDR brachytherapy.

At volume study, transrectal sonographic images of the prostate were acquired. Three fiducial seeds were implanted at volume study to facilitate reproducing prostate position at the time of implantation. Treatment planning was conducted using the PSID V4.5.1.0 treatment planning software (Eckert & Ziegler BEBIG GmbH, Berlin, Germany). The prostate was contoured, and the planning target volume (PTV) generated using a 3 mm expansion (excluding the rectum). The prescribed dose was 145 Gy to the PTV.

Seed implantation was performed under transrectal ultrasound (ProFocus 2202, B-K Medical, Herlev, Denmark) and fluoroscopic (Mobile C-arm, Model OEC 9800, GE Healthcare, Fairfield, USA) guidance. Seeds were deployed via 33 transperineal needles preloaded with 0.40mCi 125I seeds (Advantage-StrandTM, model IAI-125A, IsoAid LLC, Port Richey, Florida, USA) using an 18-gauge disposable grid (CIVCO Medical Solutions, model 610–906, Kalona, Iowa, USA). Thirty-one needles containing SS and two needles containing single LS were used, resulting in the implantation of 91 SS and 2 LS.

Fluoroscopic imaging acquired immediately after the implantation showed no seed migration ([figure 1A](#)). Likewise, CT of the pelvis performed the following day located all 93 seeds within the vicinity of the prostate.

At day 30, patient's chest X-ray was clear. However, the pelvic X-ray ([figure 1B](#)) showed that a strand of four seeds had migrated to the right pelvic sidewall. Non-contrast CT pelvis ([figure 1C,D](#)) confirmed the presence of a strand of four ectopic seeds in the right pudendal vein, posterior to the right acetabulum. The remaining 89 seeds were located in the vicinity of the prostate.

Interventions to either retrieve the four seeds or implant more seeds into the prostate were explored and judged to have a poor risk–benefit ratio for two main reasons. First, biopsy results indicated that the patient's disease was confined to the left apex of the prostate gland. The lost seeds originated from the right prostatic region and repeat

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Figure 1 (A) Fluoroscopic image taken immediately postimplantation. Red arrows denote location of the three fiducial seeds. (B) Plain X-ray of the pelvis taken at day 30 postimplantation. Black arrows denote location of the string of four migrated seeds, red arrows denote location of the three fiducial seeds while the blue arrows denote location of coils used in hernia repair. (C) CT scan (maximum intensity projection) showing a thick slice through the pelvis demonstrating three of the four migrated seeds (red arrows) along the course of the internal pudendal vein. The sciatic nerve (not shown here) should be in the vicinity. The yellow arrow denotes a small phlebolith and the blue arrows denote the coils used for previous hernia repair. (D) CT scan three-dimensional reconstruction using surface-shaded display, viewing from posterior, with black arrows denoting the string of four migrated seeds equally spaced in a linear fashion suggesting that the seeds are still attached with each other and confined in the vein.

dosimetry studies confirmed that the left apex of the prostate remained well dosed despite the seed loss. Second, the potential risks of attempting to retrieve the migrated seeds outweighed the potential clinical consequence of the migrated seeds remaining in the right pelvic sidewall. The most critical structure of concern located close to the migrated seeds is the right sciatic nerve.

At 3-month follow-up, the patient reported urinary frequency and urgency as expected, with International Prostate Symptom Score (IPSS) increasing from 1, prior to procedure, to 20. He also reported persistent bowel dysfunction characterised by frequency and urgency. Colonoscopy performed 12 months after brachytherapy found diverticular disease but no evidence of radiation-induced damage. The patient also experienced diminished erectile function and loss of libido. The patient did not report any pain, weakness or change in sensation in the distribution of right sciatic nerve.

OUTCOME AND FOLLOW-UP

At 2 years post-treatment, the patient's PSA had fallen to 0.69 µg/L indicating that good disease control had been achieved despite the seed loss. The patient remained asymptomatic with respect to the migrated seeds.

DISCUSSION

Seed migration in LDR prostate brachytherapy is a relatively common occurrence with reports describing seed migration within the pelvis as well as to distant organs such as the lungs, heart and kidneys.^{4 8 9} Embolic seed migration has been implicated in causing myocardial infarction,⁹ radiation-induced secondary malignancy¹⁰ and radiation neuropathy.⁸

Stranding has proven to be a successful strategy in reducing seed migration in prostate LDR brachytherapy. The use of SS in the peripheral sections of the prostate is now commonplace,

although most centres use a combination of SS and LS to achieve optimal dosing of the prostate.² As such, most of the studies evaluating the effect of the SS use on seed loss were based on brachytherapy cases with a mixed population of SS and LS.¹¹ These studies reported an overall reduction in seed loss compared with LS alone.

A limitation of these studies was that LS and SS were deployed, making it difficult to determine whether the migrated seeds were originally SS or LS.^{2 6} It is of note that none of the reports we are aware of describe a migration of multiple seeds into the same area. This implies that the migrating seeds in these studies were either LS, or alternately were SS that became separated from the strand only after the vicryl suture had dissolved.

There is one report of a migration of seeds in patients implanted exclusively with SS.⁷ This study found that the SS approach eliminated venous migration but that a significant number of seeds were lost through the urinary tract. The authors proposed that seed strands migrated from base of the prostate into the bladder through tracts created by needles that were initially too far advanced and then retracted.

Another factor that has been thought to increase risk of venous seed migration is the routine implantation of seeds outside of the prostate. The rationale for periprostatic implantation is to ensure adequate dose beyond prostate capsule to account for potential extraprostatic extension of disease. However, it has been reported that the planned number of extraprostatic LS placement is a significant predictor of pulmonary seed migration.⁴ Contrary to this, it has been reported that there was no correlation between placement of seeds outside the prostate and seed migration.¹

In this case, radiographs show that the migrated seeds are linearly arranged and the original spacing of seeds appears to have been maintained, suggesting that migration occurred soon after

implantation while they were still linked by the vicryl suture. The position of the seeds, in the right pelvic wall, makes it very unlikely that they migrated directly via a needle tract. This strand of four seeds is likely to have been one intentionally implanted extraprostatic in the right posterolateral aspect of the prostate. Either from direct puncture of the prostate venous plexus by the needle at the time of implantation, or intravasation of the seeds into the prostate venous plexus with changes in body position, respiration and motion, the strand of seeds would then have migrated proximally to the right internal pudendal vein. As prostate venous plexus contains no valves, the seeds were able to travel some distance before lodging in the pelvic wall. While stranding of the seeds did not prevent migration through the prostatic venous plexus, it is likely that it prevented further migration to distant and more critical organs, for example, lung and heart.

At 2 years, PSA levels of 0.69 µg/L in this patient suggest good disease control despite loss of seeds. The patient has not reported any neuropathic pain, paresthesia in the right lower limb in the distribution of the sciatica nerve, or any weakness in

his right foot, to suggest radiation neuropathy. We do recognise radiation neuropathy is a late effect and will continue to monitor patient closely for symptoms and signs of neuropathy.

Contributors All the authors have compiled and interpreted radiology images and provided appropriate text for the manuscript.

Competing interests None.

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REFERENCES

- 1 Merrick GS, Butler WM, Dorsey AT, *et al.* Seed fixity in the prostate/periprostatic region following brachytherapy. *Int J Radiat Oncol Biol Phys* 2000;46:215–20.
- 2 Tapen EM, Blasko JC, Grimm PD, *et al.* Reduction of radioactive seed embolization to the lung following prostate brachytherapy. *Int J Radiat Oncol Biol Phys* 1998;42:1063–7.
- 3 Kunos CA, Resnick MI, Kinsella TJ, *et al.* Migration of implanted free radioactive seeds for adenocarcinoma of the prostate using a Mick applicator. *Brachytherapy* 2004;3:71–7.
- 4 Eshleman JS, Davis BJ, Pisansky TM, *et al.* Radioactive seed migration to the chest after transperineal interstitial prostate brachytherapy: extraprostatic seed placement correlates with migration. *Int J Radiat Oncol Biol Phys* 2004;59:419–25.
- 5 Al-Qaisieh B, Carey B, Ash D, *et al.* The use of linked seeds eliminates lung embolization following permanent seed implantation for prostate cancer. *Int J Radiat Oncol Biol Phys* 2004;59:397–9.
- 6 Fuller DB, Kozlowski JA, Feng AC. Prostate brachytherapy seed migration and dosimetry: analysis of stranded sources and other potential predictive factors. *Brachytherapy* 2004;3:10–19.
- 7 Saibishkumar EP, Borg J, Yeung I, *et al.* Sequential comparison of seed loss and prostate dosimetry of stranded seeds with loose seeds in 125I permanent implant for low-risk prostate cancer. *Int J Radiat Oncol Biol Phys* 2009;73:61–8.
- 8 Hau EK, Oborn BM, Bucci J. An unusual case of radioactive seed migration to the vertebral venous plexus and renal artery with nerve root compromise. *Brachytherapy* 2011;10:295–8.
- 9 Zhu AX, Wallner KE, Frivold GP, *et al.* Prostate brachytherapy seed migration to the right coronary artery associated with an acute myocardial infarction. *Brachytherapy* 2006;5:262–5.
- 10 Chen WC, Katcher J, Nunez C, *et al.* Radioactive seed migration after transperineal interstitial prostate brachytherapy and associated development of small-cell lung cancer. *Brachytherapy* 2012;11:354–8.
- 11 Reed DR, Wallner KE, Merrick GS, *et al.* A prospective randomized comparison of stranded vs. loose 125I seeds for prostate brachytherapy. *Brachytherapy* 2007;6:129–34.

Learning points

- To the best of our knowledge, this case describes the first report of venous migration of an entire strand of four seeds in low-dose-rate prostate brachytherapy.
- This case confirms that venous migration with stranded seed is not impossible.
- In order to reduce the risk of venous seed migration in future cases, our institution now adopts a strategy of minimising the use of loose seeds, and ensures that each strand of seeds implanted pierces the prostate parenchyma at some point which will hopefully act as an anchor and prevent strand migration away from the prostate.

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