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Case Report

A Case of Migration of a Hydrogel Spacer for Radiotherapy into the Pulmonary Artery

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A 67-year-old man was referred to our hospital for the diagnosis and treatment of prostate cancer. Multidisciplinary discussion led to intensity-modulated radiotherapy preceded by hormone therapy. Before radiotherapy, a biodegradable hydrogel spacer (HS) was placed between the prostate and rectum to reduce radiation injury risk. Three weeks postplacement, pelvic magnetic resonance imaging revealed HS migration into the pelvic vein. Subsequent whole-body contrast-enhanced computed tomography (CECT) revealed HS migration into the pulmonary artery. The patient showed no symptoms or clinical signs. Radiotherapy was completed uneventfully. Complete absorption of the migrated HS was confirmed using CECT images 5 months postplacement.

Key words: hydrogel spacer, prostate cancer, radiotherapy, pulmonary embolism

Radiotherapy is one of the most common treatment options for early-stage prostate cancer. Recently, radiation doses have been increased to enhance their effectiveness, resulting in higher radiation exposure to the organs surrounding the prostate (*e.g.*, the rectum and bladder). Several techniques can be used to reduce the risk of radiation-induced injury to these organs. A biodegradable hydrogel spacer (HS) is often placed between the prostate and rectum to reduce radiation exposure to the anterior rectal wall [1]. The HS maintains its space for 3 months, after which hydrolysis begins, leading to the complete absorption of the HS within 12 months after placement [1]. In a previous study of 200 patients, the complications related to HS placement included rectal wall infiltration, prostate subcapsular infiltration, hematuria, vasovagal reflex, urinary retention, and corpus spongiosum migration [2]. Intravascular migration of the HS has also been reported as a rare complication [3,4]. To the best of our knowledge, however, migration into the pulmonary artery has not yet been reported. Herein, we report a case of an HS that migrated to the pulmonary artery.

Case Report

A 67-year-old man with a high prostate-specific antigen level (12.5 ng/ml) was referred to our hospital. The patient had a medical history of postoperative sigmoid colon cancer, hemorrhoids, and right inguinal hernia. The findings of pelvic magnetic resonance imaging (MRI) strongly suggested prostate cancer, which was confirmed by biopsy (Gleason score, 3+4). After a multidisciplinary discussion, we decided to per-

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form radical radiotherapy preceded by hormone therapy for the treatment of intermediate-risk prostate cancer.

One year after the initiation of the hormone therapy, an HS (SpaceOAR™ System, Boston Scientific, Marlborough, MA, USA) was placed between the prostate and rectum under ultrasound guidance to avoid complications due to intensity-modulated radiotherapy (IMRT). Three weeks after placement, MRI was performed to facilitate IMRT planning. T2-weighted images showed a small amount of HS between the prostate and rectum as well as in the pelvic vein, mainly around the prostate. Based on these findings, we diagnosed the patient with intravascular migration of the HS (Fig. 1) and performed contrast-enhanced whole-body computed tomography (CT). CT showed contrast defects in the pulmonary artery and the pelvic vein. Furthermore, the CT attenuation values of the embolic material in the pulmonary artery were similar to those in the pelvic vein and were deemed lower than those in thrombi. Therefore, the embolic material in the pulmonary artery was considered to have migrated to the HS (Fig. 2), and no additional testing was done. However, no therapy was administered because the patient was asymptomatic without any clinical signs and showed neither a decrease in SpO2 nor any change in vital signs.

Radiotherapy was initiated as scheduled and completed after 1 month without complications. Hydrogel spacers are completely absorbed in 6-12 months after placement [1], follow-up contrast-enhanced CT 5 months after HS placement showed that the HS in the pulmonary artery and pelvic vein, as well as between the prostate and rectum, had disappeared (Fig. 3).

Discussion

Complications related to HS placement are usually mild and transient, occurring in 0-10% of patients [3]. In a study of 200 cases by Yamaguchi *et al.*, there were 11 cases of HS migration into the rectum, 1 case of migration into the rectal wall and prostate subcapsule, 1 case of hematuria, 2 cases of vasovagal reflex, 1 case of urinary retention, and 1 case of migration into the corpus spongiosum [2]. The asymmetric distribution of HS is relatively common, and a significant transverse deviation (>2 cm) cannot reduce the rectal dose [5]. Moreover, migration to various locations, including the rectal wall, prostate capsule, and blood vessels, has been reported after HS placement [4,6]. Migration to the rectal wall occurs in approximately 6% of cases [5], and rectal ulceration has also been reported [7]. Therefore, pelvic MRI should be evaluated for both HS morphology and migration before radiotherapy. If the migration observed on pelvic MRI is large, whole-body contrast-enhanced CT should be performed to evaluate the distribution of the HS, particularly in the pulmonary arteries.

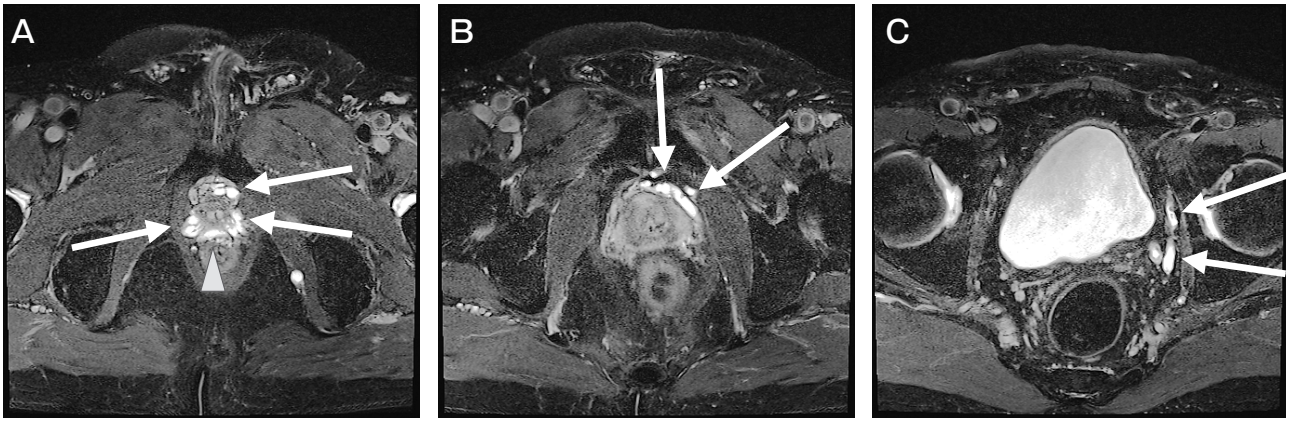

Fig. 1 Magnetic resonance imaging scans performed 3 weeks after HS placement. (**A**,**B**,**C**): Fat-saturation T2-weighted images reveal a pronounced signal intensity of the HS located between the prostate and rectum, albeit in a relatively small quantity compared to the normal HS amount (arrowhead). In the veins around the prostate and left side of the pelvis, the high signal intensity same as that of the HS is shown (arrows).
HS, hydrogel spacer.

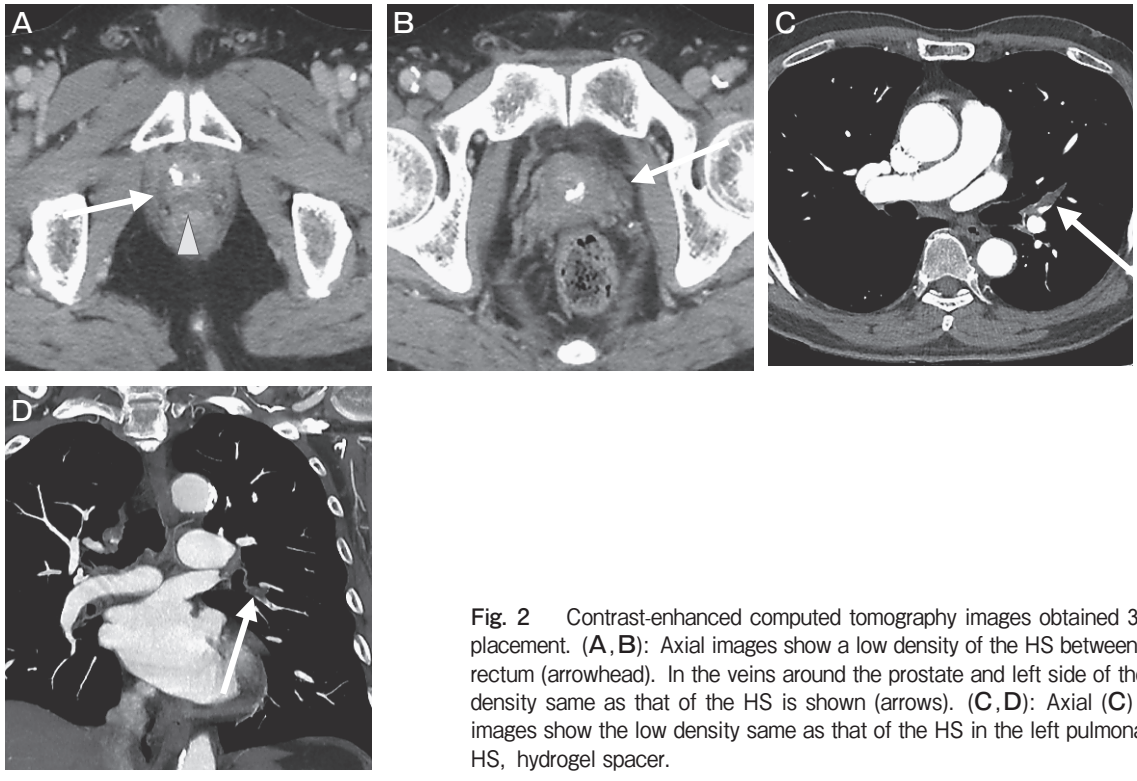

Fig. 2 Contrast-enhanced computed tomography images obtained 3 weeks after HS placement. (**A**, **B**): Axial images show a low density of the HS between the prostate and rectum (arrowhead). In the veins around the prostate and left side of the pelvis, the low density same as that of the HS is shown (arrows). (**C**, **D**): Axial (**C**) and coronal (**D**) images show the low density same as that of the HS in the left pulmonary artery.
HS, hydrogel spacer.

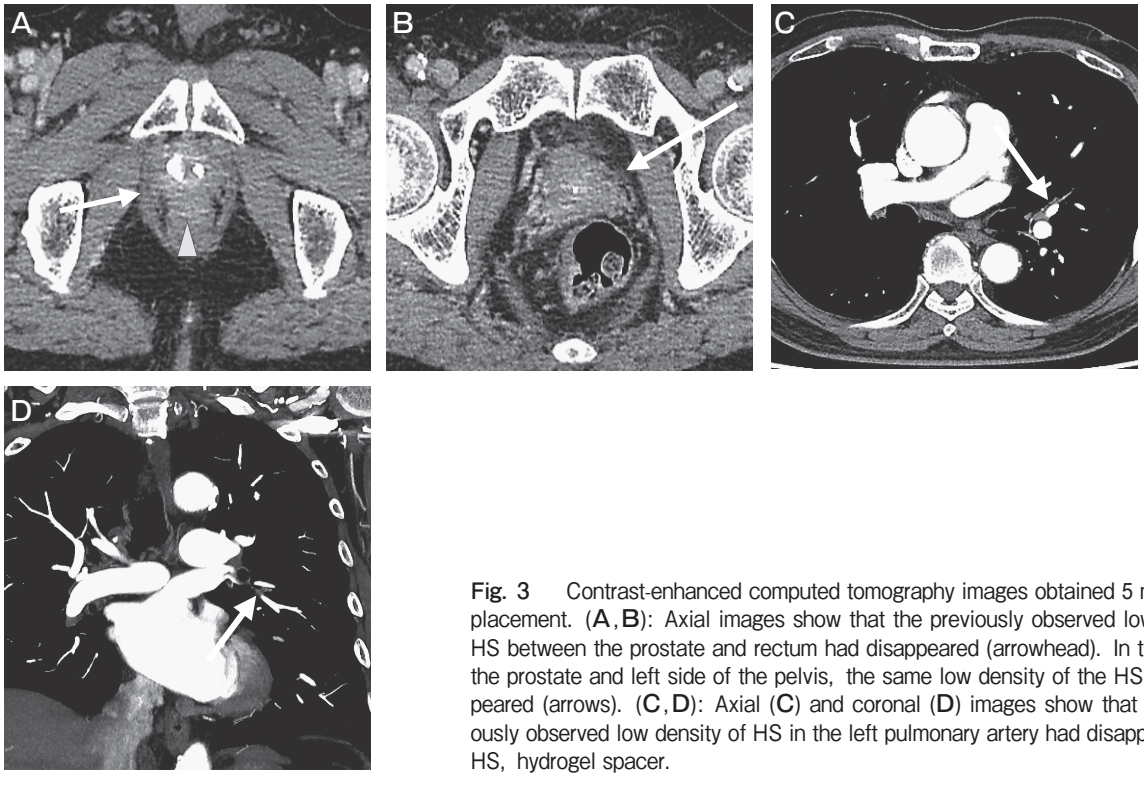

Fig. 3 Contrast-enhanced computed tomography images obtained 5 months after HS placement. (**A**, **B**): Axial images show that the previously observed low density of the HS between the prostate and rectum had disappeared (arrowhead). In the veins around the prostate and left side of the pelvis, the same low density of the HS also had disappeared (arrows). (**C**, **D**): Axial (**C**) and coronal (**D**) images show that the same previously observed low density of HS in the left pulmonary artery had disappeared.
HS, hydrogel spacer.

Patients with malignancies generally have an increased risk of venous thrombosis [8]. Therefore, it may be difficult to distinguish thrombi from HS migrations in a clinical setting. A previous study showed that the CT attenuation value of a thrombus was 66 HU within 8 days of clinical diagnosis, which then decreased to 55 HU [9]. In our patient, the CT value of the embolic material was approximately 10 HU, which is much lower than that of the thrombus. Therefore, CT attenuation values may be useful in differentiating HS migration from thrombi.

Intravascular migration is assumed to result from a direct puncture of the venous plexus during placement [4]. However, pelvic adhesions could be the cause of intravascular migration because it is difficult to clear the space between the prostate and rectum. In the present case, adhesions were expected because the patient had undergone a pelvic procedure. Therefore, intravascular migration during HS placement should be considered in patients with pelvic adhesions.

In conclusion, we encountered the rare complication of HS migration into the pulmonary artery before radiotherapy for prostate cancer. After the completion of radiotherapy, the migrated HS was absorbed uneventfully.

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