Case Report



# Inguinal Hernia Containing the Bladder and Postoperative Appearance: A Multimodality Case Report

Hala Jasim , Orhan Öz , Joseph Frankl *

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# Inguinal Hernia Containing the Bladder and Postoperative Appearance: A Multimodality Case Report

**Hala Jasim, Orhan Öz and Joseph Frankl ***

University of Texas Southwestern Medical Center, Department of Radiology

* Correspondence: joseph.frankl@utsouthwestern.edu

**Abstract**

A 79-year-old man with prostate cancer underwent initial staging prior to prostatectomy with $^{99m}$Tc-methylene diphosphonate ($^{99m}$Tc-MDP) bone scintigraphy. Anterior and posterior images showed focal uptake overlying the pubic symphysis. Lateral views showed that the activity was extraosseous. Follow-up CT urography showed a bladder hernia as cause of the abnormality on bone scan. Prostatectomy and inguinal hernia repair were performed as a combination case. Four years postoperatively, follow-up $^{68}$Ga-PSMA-11 positron emission tomography/computed tomography (PET/CT) showed no recurrence. The CT component of the exam show an intermediate density focus at the right inguinal hernia repair site, corresponding to a polypropylene mesh plug, and a hyperattenuating Gore-Tex mesh repair of the left inguinal hernia. This case highlights the importance of lateral projections in resolving scintigraphic pitfalls and recognizing mesh-related imaging appearances to prevent misinterpretation.

**Keywords:** inguinal hernia; bone scan; MDP; PSMA; mesh plug; prostate cancer

## 1. Introduction

Bladder herniation into the inguinal canal is rare, occurring in 0.4–3% of the population and accounting for 1–4 % of all inguinal hernias[1]. Elderly men are most commonly affected. This condition creates a diagnostic challenge for nuclear medicine tests that rely on radiotracers excreted into the urine. The atypical location and possible discontinuity of urinary activity in the hernia neck requires recognition. Otherwise, activity overlying the groin could be misinterpreted as osteoblastic disease. Inguinal hernias can be treated with multiple surgical techniques. The patient in this case report was ultimately treated with two types of surgical mesh. Postoperative appearances of the different mesh materials are reviewed.

The specific etiology of inguinal hernias in a given patient is uncertain. Anatomically, inguinal hernias are divided into medial and lateral hernias. Medial hernias, also known as direct hernias, arise from Hesselbach's triangle through a weakened transversalis fascia[2]. They make up a minority of inguinal hernias and are more common in older adults[3]. Lateral hernias, also known as indirect hernias, originate at the internal inguinal ring, run in the inguinal canal, and may exit the superficial inguinal ring[2]. The internal inguinal ring is normally covered by the processus vaginalis and a patent processus vaginalis puts patients at risk of lateral inguinal hernias[4]. Lateral inguinal hernias are more common that medial inguinal hernias and occur in a bimodal age distribution with peaks in youth and old age[3]. Additional factors shown to increase lifetime risk of inguinal hernias include connective tissue diseases and smoking (which degrades connective tissue architecture)[5,6], occupational heavy lifting[7], and conditions that increase intra-abdominal pressure like chronic obstructive pulmonary disease and peritoneal dialysis[8]. Although obesity is thought to increase intra-abdominal pressure, it is actually associated with a lower incidence of detected inguinal hernias[9] which may be in part due to hernias being easier to detect in lean versus obese patients.

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Many small inguinal hernias are incidentally detected on cross-sectional imaging and do not require treatment. However, acute complications can occur in inguinal hernias of various sizes and large inguinal hernias can cause bothersome chronic symptoms. Incarceration is trapping of hernia contents in the hernia sac. Incarcerated tissue can swell because of impaired venous and lymphatic drainage and ultimately lead to ischemia and necrosis, which is known as strangulation[10]. Herniated bowel poses risk of bowel obstruction involving the upstream and/or herniated bowel loop. Obstruction of herniated bowel at the upstream and downstream segments as it passes through the hernia neck is a closed loop obstruction requiring rapid intervention to prevent bowel necrosis. Occasionally, other organs such as the bladder can enter an inguinal hernia sac.

Surgery is the definitive therapy for inguinal hernias[11]. Operative intervention is required urgently in the setting of complications like strangulation. However, may patients may receive elective surgical repair allowing for planning of treatment timing and method. Surgical repair can be performed open, laparoscopically, and with robotic assistance. Tension free mesh repairs and non-mesh, primary tissue repairs can be performed, with non-mesh repairs being associated with increased risk of hernia recurrence and injury to adjacent structures[12]. Laparoscopic hernia repairs were initially performed via the transabdominal preperitoneal method, where the abdominal cavity is entered to create a larger working space and ability to access both inguinal hernias for bilateral repair if needed. However, there is increased risk of bowel injury and adhesions compared to the newer totally extraperitoneal method where the surgery is performed in the preperitoneal space and thus avoids some of the risks of intrabdominal surgery[13]. Most inguinal hernia mesh repairs are performed with polypropylene mesh, which induces an inflammatory response that is important in the repair of inguinal hernias[14]. Expanded polytetrafluoroethylene (ePTFE) mesh produces a lesser inflammatory response and is more often used for the repair of incisional hernias but may be used for inguinal hernia repairs in some instances at surgeon's discretion.

## 2. Detailed Case Description

### *2.1. Clinical Context*

A 79-year-old man with a history of deep venous thrombosis and pulmonary embolism requiring long term anticoagulation, bilateral inguinal hernias treated surgically, and prostate cancer treated with radical prostatectomy required evaluation for metastatic disease after biochemical recurrence.

Initial workup for his prostate cancer had shown up to Gleason score 4+4 (grade group 2) disease. Prostatectomy and inguinal hernia repair were performed as a combination surgery with urologic and general surgeons completing their respective procedures during the same anesthesia event. Pathology from prostatectomy showed highest Gleason score of 3+5 (grade group 4) disease and positive posterolateral margins from the base to apex. Seminal vesicle invasion was present. Bilateral pelvic nodal dissections were negative for metastatic prostate cancer. The general surgery team approached their procedure transabdominally and found a large right-sided medial hernia and a moderate left-sided lateral hernia. Polypropylene mesh was used for repair of the right-sided hernia. Dissection to expose the left hernia resulted in several peritoneal defects and the decision was made to use ePTFE mesh to avoid direct contact of inflammatory polypropylene mesh with intraperitoneal contents such as bowel.

The patient had a PSA recurrence four years after prostatectomy to 0.31 ng/ml prompting additional workup for metastatic or recurrent disease. We present imaging done before surgical treatment (bone scan and CT urography) and after biochemical recurrence (PET/CT) to demonstrate the appearance of the bladder containing inguinal hernia and appearance of the mesh hernia repair.

### *2.2. Bone Scan*

Intitial staging whole-body $^{99m}$Tc-MDP bone scintigraphy showed focal intense activity projecting over the right pubic symphysis (Figure 1, A). However, the lateral projection (Figure 1, B)

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localized the activity anterior to the expected location of the pubic bones suggesting an extraosseous location. Planar bone scintigraphy lacks anatomic detail, limiting differentiation between osseous and extraosseous uptake, whereas single photon emission computed tomography/computed tomography enables precise localization. This highlights the importance of obtaining lateral or oblique views to rule out skeletal involvement in the pelvis*[15]*. False-positive uptake may occur when tracer-containing urine accumulates within a herniated bladder segment or a focal bladder diverticulum, mimicking metastasis if the connection to the bladder is obscured by a narrow neck*[16]*.

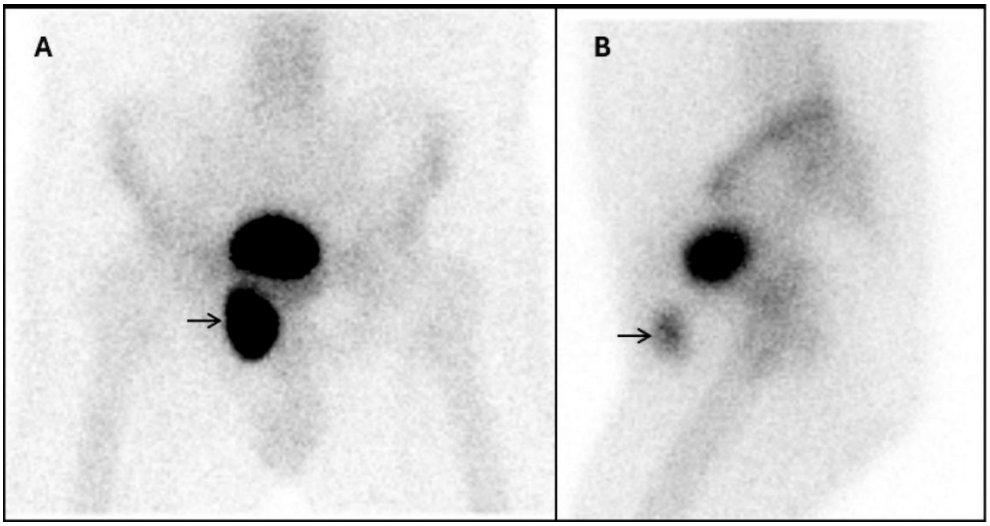


**Figure 1.** Planar images from $^{99m}$Tc-MDP bone scintigraphy. Abnormal activity projects over the right pubic symphysis on the anterior projection (A) and is shown to be anterior to the expected location of the pubic bones on lateral projection (B).

*2.3. CT Urogram*

Subsequent CT urography demonstrated a right inguinal hernia containing fat and a portion of the bladder. The herniated bladder only filled on the delayed prone phase (Figure 2, B, image flipped), confirming bladder communication. The sagittal reconstruction (Figure 2, D) demonstrates the course of the narrowed bladder through the hernia neck.

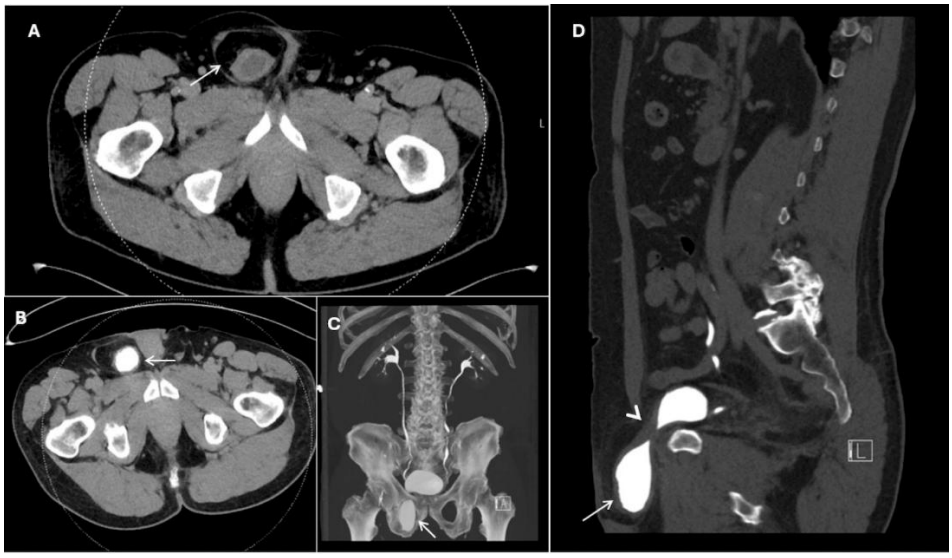


**Figure 2.** CT urography. The precontrast phase (A) shows a soft tissue density with central fluid density in the right inguinal canal. On delayed prone imaging (B), excreted contrast is seen within the abnormality indicating it communicates with the bladder. Please note these images are flipped vertically. A maximum intensity

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projection (C) shows the herniated bladder's location in relationship to the pelvic bones. A delayed sagittal reconstruction (D) shows the thin neck (arrowhead) as the hernia enters the inguinal canal. Contrast is again seen in the herniated bladder (arrow).

*2.4. PSMA PET/CT*

Follow-up $^{68}$Ga-PSMA-11 PET/CT four years after prostatectomy did not demonstrate radiotracer avid recurrent or metastatic disease. Axial localizer CT through the pelvis (Figure 3, B) demonstrated a rounded soft-tissue density focus at the right hernia-repair site representing a polypropylene mesh plug. This was initially thought to represent residual herniated bladder before more thorough investigation of the patient's surgical history. Dense material at a left inguinal hernia repair site represents ePTFE mesh, commonly known as Gore-Tex. ePTFE appears hyperattenuating due to its inert, non-adhesive coating and was selected at surgery for laparoscopically confirmed contact with peritoneal surfaces on the left side, whereas polypropylene mesh is isoattenuating and may appear as a rounded density. Although non-avid in this case, PSMA-ligand uptake has been reported in association with mesh-related neovascularization and increased ligand expression in chronic inflammation[17]. [18]F-fluorodeoxyglucose uptake can also occur years after mesh hernia repair because of inflammation[18].

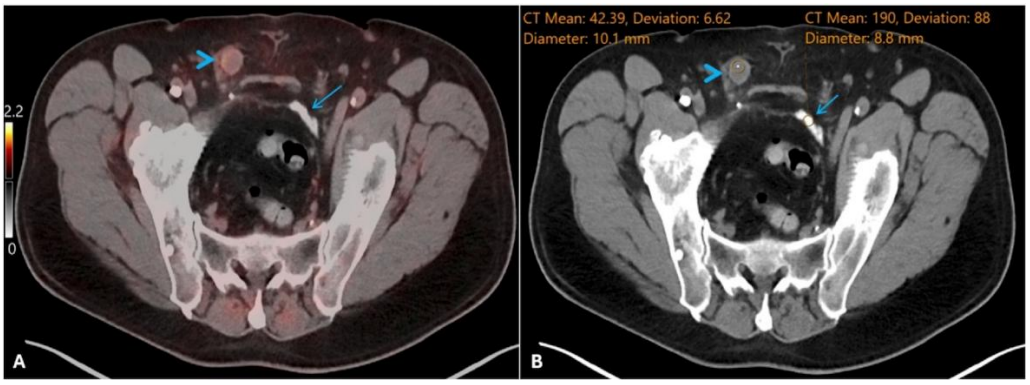


**Figure 3.** PSMA PET/CT following bilateral inguinal hernia repair. Fused (A) and localizer CT (B) images are shown. A soft tissue density in the right inguinal canal represents a polypropylene mesh plug (arrowhead). Linear high-density material at entrance of the left inguinal canal is ePTFE mesh. Minimal activity is seen at the mesh plug despite aggressive windowing.

## 3. Discussion

Awareness of possible abnormal bladder configurations is essential for interpreting nuclear medicine studies with radiotracers that are excreted in the urine. Urinary activity can overlap osseous structures on bone scintigraphy making assessment challenging. Recognition of this pitfall on planar imaging can involve identifying 1) atypical pelvic radiotracer location, 2) activity level similar to bladder, 3) continuity with the bladder, and 4) a teardrop- or tongue-shaped contour**[15,19–21]**. Hybrid imaging can assist in challenging cases. Follow up cross-sectional imaging, including CT urography, can help define anatomy.

Several reports of inguinal hernias containing bladder detected on bone scintigraphy have been published. Iagaru and Siegel presented a case showing a bladder diverticulum in an inguinal hernia detected on bone scintigraphy**[22]**. Ilgan et al. demonstrated a case where the entire bladder and portion of the distal ureters herniated into the scrotum via the right inguinal canal resulting in distal left ureteral obstruction**[22]**. Other reports have shown portions of the anterior bladder entering inguinal hernias, as was the case in our report**[23]**.

Following hernia repair, it is essential to recognize that nodular soft tissue densities may be post-surgical mesh plugs. Mesh plugs can be radiotracer avid with tracers that frequently have inflammatory uptake and should not be confused with metastatic disease. There are reports of

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potential false positive radiotracer uptake by herniorrhaphy mesh on PSMA**[24]** and FDG**[25]** PET/CT. $^{68}$Ga-DOTATATE is known to have false positive uptake with inflammatory processes and could conceivable show activity at hernia repair mesh, although there are no reported cases in the literature.

In summary, herniation of the urinary bladder can cause abnormal configuration of urinary activity found with many diagnostic radiopharmaceuticals. Following repair of inguinal hernias, the radiologist must also be aware of the range of postoperative appearances of mesh repairs and possible inflammatory radiotracer uptake.

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**Data Availability Statement:** Not applicable.

**Conflicts of Interest:** The authors declare no conflicts of interest.:

## Abbreviations

The following abbreviations are used in this manuscript:

| | |
|---|---|
| ePTFE | Expanded polytetrafluoroethylene |
| PET/CT | Positron emission tomography/computed tomography |
| $^{99m}$Tc-MDP | $^{99m}$Tc-methylene diphosphonate |

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