


Inadvertent intravesicular placement of a vaginal contraceptive ring: a case report and review of literature

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ABSTRACT

The NuvaRing® is a deformable, ring-shaped hormonal contraceptive device which is typically vaginally self-inserted by the patient. While there are several potential side effects of usage, essentially all of them result from hormone delivery. Complications from incorrect placement are rare. We present the case of a 31 year old female who presented to our emergency department after being unable to retrieve a NuvaRing® for its scheduled removal. CT scan showed a hypodense intravesicular NuvaRing® which the patient had inadvertently placed transurethral 3 weeks prior. Cystoscopy was performed and retrieval using a 3-pronged grasper was eventually successful after several failed attempts with an alligator grasper. Our purpose in presenting this case is to introduce the reader to a rare complication of incorrect NuvaRing® placement, explain how this complication may occur as a result of NuvaRing® construction/functionality, describe how alternative cystoscopic instruments may aid in cystoscopic retrieval, and review the 3 other case reports of intravesicular NuvaRing® placement to discuss the utility of various imaging modalities when clinical suspicion of the complication is high.

CASE REPORT

INTRODUCTION

The NuvaRing® is a flexible, ring-shaped hormonal contraceptive device which is vaginally inserted by the patient and positioned to surround the cervix. Hormones are then delivered to the vaginal mucosa for 3 weeks and the device is then removed to cease hormonal delivery and trigger breakthrough bleeding. A new device is placed 7 days after ring removal, and the cycle is restarted [1].

While there are several known potential adverse reactions to NuvaRing® usage, essentially all of them are secondary to hormonal delivery. Complications from its placement are

quite rare, with only 3 other reports of intravesicular placement found in the literature [1-4].

Our purpose in presenting this case is to introduce the reader to a very rare complication of NuvaRing® usage which may occur in patients without psychiatric or physical comorbidities, review the structure and functionality of the NuvaRing® to explain how the complication may occur, describe how alternative cystoscopic instruments may aid in successful transurethral NuvaRing® removal, and to conduct a literature review to address the utility of various imaging modalities when clinical suspicion of intravesicular NuvaRing® is high.

CASE REPORT

A 31 year old Caucasian female presented to our emergency department after being unable to retrieve a NuvaRing® for its scheduled removal 3 weeks after its initial self-placement. The patient had not experienced expulsion of the device and therefore feared that she had placed the NuvaRing® transurethrally. The patient was G2P2, 2 months postpartum, and had just started NuvaRing® contraception for the first time after the birth of her second child. She acknowledged urinary frequency and mild dysuria over the past few weeks. When questioned, the patient described some discomfort during initial placement of the NuvaRing®, but was unaware that the discomfort was abnormal since it was her first time placing the device. Surgical history was remarkable for a remote history of appendectomy 15 years prior to presentation. She denied any significant further medical, surgical, psychiatric, or relevant family history.

On initial physical examination, no significant abnormality was noted. Examination of the perineum did not reveal any blood or abnormal urethral drainage. Speculum vaginal exam failed to demonstrate an intravaginal NuvaRing®. Vital signs were within normal limits. A complete blood cell count and chemistry panel were unremarkable. Laboratory urinalysis documented the collected urine as yellow in color and hazy in clarity. There was a "large" amount of microscopic blood (normal: none), increased protein content at 30 mg/dL (normal: 0 mg/dL), a moderate amount of leukocyte esterase (normal: none), 112 red blood cells per high power field (HPF, normal: 0-2), 50 white blood cells per HPF (normal: 0-2), moderate amount of squamous and transitional cell epithelium per HPF, moderate amount of bacteria per HPF, and occasional mucus per HPF. Urine beta-HCG was negative. A urine culture was sent, which eventually returned as greater than 100,000 colony forming units per mL of Escherichia Coli.

A noncontrast computed tomography (CT) scan of the pelvis was obtained to evaluate the presence and position of the NuvaRing®. The CT scan demonstrated the NuvaRing® within the bladder as a circular structure hypodense to the surrounding urine (Figure 1). The patient was then admitted and given intravenous ciprofloxacin and pain control overnight. The following morning, the patient was taken to the operating room for cystoscopic removal.

The patient was given general anesthesia and was placed in the dorsal lithotomy position on the operating table. After sterilization, a 23 French cystoscope was advanced through the urethra into the bladder. A NuvaRing® was readily seen and an attempt was made to grasp the ring with an alligator grasper, which failed as a result of the alligator grasper being too weak to hold the NuvaRing® and adequately deform the ring to the elongated shape necessary to be pulled through the urethra. A 3-prong grasper was then used and successfully removed the NuvaRing® through the urethra intact. Following its removal, the NuvaRing® was measured as 4.5 cm in diameter and 0.4 cm in thickness. The patient was then extubated and sent to the recovery room in stable condition. Blood loss was reported as minimal.

The patient recovered without incident and was discharged the same day on an oral antibiotic regimen. She has had no recurrence of symptoms or health issues since the procedure, and switched to oral contraceptives after this episode.

DISCUSSION

Introduction, etiology, and demographics

The NuvaRing® is a flexible, ring-shaped combined hormonal contraceptive device which is vaginally inserted (typically by the patient) to above the level of the urogenital diaphragm. The compliance and flexibility of the device allow the ring to collapse for more comfortable vaginal insertion and for it to undergo slight compression by the vaginal walls into an oblong shape once it is fully into position surrounding the cervix [1]. The NuvaRing® is intended to remain in place for 3 weeks, during which it releases about 0.015 mg/day of ethinyl estradiol (EE) and 0.120 mg/day of etonogestrel. These hormones are absorbed by the highly vascular vaginal mucosa and avoid first-pass hepatic metabolism, thus allowing lower doses to achieve biologic effectiveness. After 3 weeks, the NuvaRing® is removed by the patient, ceasing hormonal delivery and prompting withdrawal bleeding within 2-3 days. A new ring is then inserted 7 days after removal of the prior ring, restarting the cycle [1].

The NuvaRing® is typically well tolerated and should be effective as long as it stays in place in the vagina (even if suboptimally positioned) [1]. Adverse reactions to the NuvaRing® are usually related to effects of the delivered hormones and include a heightened risk of hyperlipidemia, hypertension, thromboembolism, stroke, myocardial infarction, liver adenomas, and cancer of the reproductive organs [1,2]. Intravesicular placement of the device is an exceptionally rare occurrence, as insertion instructions are usually explained/reviewed in the prescribing clinician's office prior to self-placement. The NuvaRing® is about 4 mm in thickness and 54 mm in diameter when fully open, and at least 8 mm in thickness when fully collapsed since both ends of the ring will be in contact. Thus, transurethral insertion of a device of this size will typically cause stretching of the female urethra (typically around 6 mm when non-dilated) with production of pain, although there is a case report of a patient who reported no pain upon transurethral passage [1,5]. It is unsurprising then that intravesicular placement is an exceptionally rare complication of NuvaRing® placement, with our case representing only the fourth reported case in the medical literature in a patient without psychiatric or physical comorbidity [2-4].

In general, intravesicular foreign bodies are uncommon, likely due to the small size of the external urethral meatus and pain encountered upon the maneuver. However, some patients do intentionally practice transurethral foreign body insertion for sexual stimulation, curiosity, or in association with a psychiatric condition [2,6]. Several case reports exist for patients with inadvertent intravesicular placement of vaginal contraceptive suppositories and traditional intrauterine contraceptive devices [2,6-7]. There is one case report of

transurethral contraceptive ring placement in a patient with a neurogenic bladder, but it is unclear what role (if any) a neurogenic bladder may have to predispose to the complication [8]. Foreign bodies (usually traditional intrauterine contraceptive devices) may also migrate to an intravesicular location from elsewhere in the abdomen/pelvis in patients with chronic inflammation or malignancy [2,9].

Clinical and imaging findings

Once within the bladder, foreign bodies can cause obstructive and irritative symptoms such as urinary frequency, dysuria, urinary retention with fractionated voiding, incontinence, and hematuria [3]. Although these symptoms are similar to uncomplicated cystitis, clinical history of antecedent NuvaRing® placement should raise concern for a causative intravesicular foreign body. The few other case reports that exist in the literature show that the patient may also present to her obstetrician believing that the device has been unknowingly expelled and lost due to its unexplained absence at the time of scheduled removal. However, as these case reports show, it should never be assumed by the patient and/or clinician that the NuvaRing® has been expelled, and further investigation to rule out the possibility of malpositioning should be considered.

Although not performed for our patient, transvaginal ultrasound is a potentially useful diagnostic modality if appropriately performed on a patient with a fluid-filled bladder. A report by Teal and Craven highlighted the need for adequate bladder distension, as an initial transvaginal ultrasound performed on a patient with an empty bladder failed to adequately demonstrate the intravesicular ring and was interpreted as normal [4]. In another report by Bhaduri and associates, the NuvaRing® was seen in section and appeared as two intravesicular hyperechoic foci which were originally mistaken for intravesicular calculi [2]. Changes in position did not produce movement of the nondependent foci, as the ring was adherent to the bladder wall from incited inflammation [2]. The third case report by Tarragón Gabarró described successful recognition of the intravesicular NuvaRing® by transvaginal ultrasound [3].

CT readily demonstrates an intravesicular NuvaRing® as a circular ring hypodense to surrounding urine [2-4,10]. An air locule can be seen within the ring, which likely is related to joining of ring ends during the manufacturing process. The ring should be about 5.4 cm in diameter, with some variation allowed from deformity of the ring which may result from limitation of its expansion within a collapsed bladder. The NuvaRing® can also be visualized in a bladder filled with excreted contrast, although less optimally than on a noncontrast examination [4]. Depending on the level of clinical suspicion and the need to evaluate the remainder of the abdomen, radiation dose may be decreased by reducing the scanned field to the craniocaudal extent of the bladder.

Plain radiography will show a NuvaRing® as a radiolucent ring, but its ability to definitively characterize the ring as intravesicular will be markedly limited [10]. On magnetic resonance imaging (MRI), a NuvaRing® is normally

seen as a circular/ovoid structure with hypointensity on T1 and T2 weighted images [11]. If incorrectly placed within the bladder, the ring will be better visualized on fluid weighted sequences due to improved contrast from the surrounding hyperintense urine.

Differential diagnosis

Other intravesicular foreign bodies

There is very little in the differential diagnosis for an intravesicular NuvaRing®, as clinical history and imaging collectively yield a high degree of specificity. The size, ring shape, characteristic hypodensity/radiolucency, and structural flexibility needed to deform the device to be able to undergo transurethral passage is a combination that is essentially exclusive to the NuvaRing®. Insertion of a similarly shaped foreign body would be highly unusual. Moreover, there would be no supportive clinical history of antecedent NuvaRing® placement. Nonetheless, other intravesicular ring-shaped foreign bodies could be entertained in a differential diagnosis, with their imaging appearance varying according to their construction and composition.

Emphysematous cystitis

Emphysematous cystitis is probably the only disease entity which can manifest as a ring of intraluminal hypodensity on CT, but the hypodensities in this entity will be of air attenuation and either in the bladder wall itself, or immediately subjacent to the bladder wall, quite different than the nearly perfect circular intraluminal hypodensity of an intravesicular NuvaRing®. The bladder wall may also be thickened and inflamed. On sonographic evaluation, emphysematous cystitis would demonstrate irregular bladder wall thickening with intramural echogenic foci and shadowing/reverberation artifact, markedly different than the intraluminal echogenic ring seen with an intravesicular NuvaRing® [2]. On MRI, air locules within the bladder wall and lumen in a patient with emphysematous cystitis will cause significant susceptibility artifact, different than the circle of T1/T2 hypointensity seen with an intravesicular NuvaRing®. Increased T2 signal may also be seen about the bladder from adjacent edema and inflammatory changes.

Treatment and prognosis

Cystoscopic surgical retrieval is the treatment of choice for an intravesicular NuvaRing®, with varying methods and degrees of success reported in the 3 other case reports in the literature. In a 2006 case report by Teal, retrieval of the intravesicular NuvaRing® was easily performed with a single pull in an outpatient setting with only local anesthesia, although the exact cystoscopic instrument used was not specified [4]. Tarragón Gabarró and associates also described an easy retrieval process with the use of a rigid cystoscope and foreign body forceps [3]. However, Bhaduri and associates described several failed attempts using conventional cystoscopic graspers due to a lack of sufficient grabbing power needed to deform the NuvaRing® to the compacted/elongated shape necessary to allow transurethral removal. The first procedure was ultimately aborted, and on a subsequent procedure with deeper sedation and general anesthesia, a

flexible catheter was used to successfully lasso the NuvaRing® and pull the device through the urethra [2]. In this presented case, the urologist also encountered initial difficulty with a standard alligator grasper, but ultimately found success with the increased grabbing strength of a 3-pronged grasper.

Conclusion

Intravesicular placement is an exceptionally rare complication of NuvaRing® usage. Patients may be asymptomatic or present with nonspecific urinary tract infection like symptoms. While a history of antecedent painful NuvaRing® insertion is often helpful in suggesting the complication, there is a case report of the transurethral placement being painless and thus further investigation with imaging may be required to rule out incorrect placement. Cystoscopic retrieval is the treatment of choice and has been performed with variable difficulty and success. Our purpose in presenting this case was to introduce the reader to a very rare complication of NuvaRing® usage which he/she may have been otherwise unfamiliar with, review the structure and functionality of the NuvaRing® to explain how the complication may occur, describe how alternative cystoscopic instruments may aid in successful transurethral NuvaRing® removal, and to conduct a literature review to address the utility of various imaging modalities when clinical suspicion of intravesicular NuvaRing® is high.

TEACHING POINT

The flexible construction of the NuvaRing® can allow for potentially asymptomatic transurethral passage of the device, and thus radiologists should be familiar with the radiologic appearance of intravesicular NuvaRing® positioning since clinicians may have incorrectly assumed interim expulsion.

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FIGURES

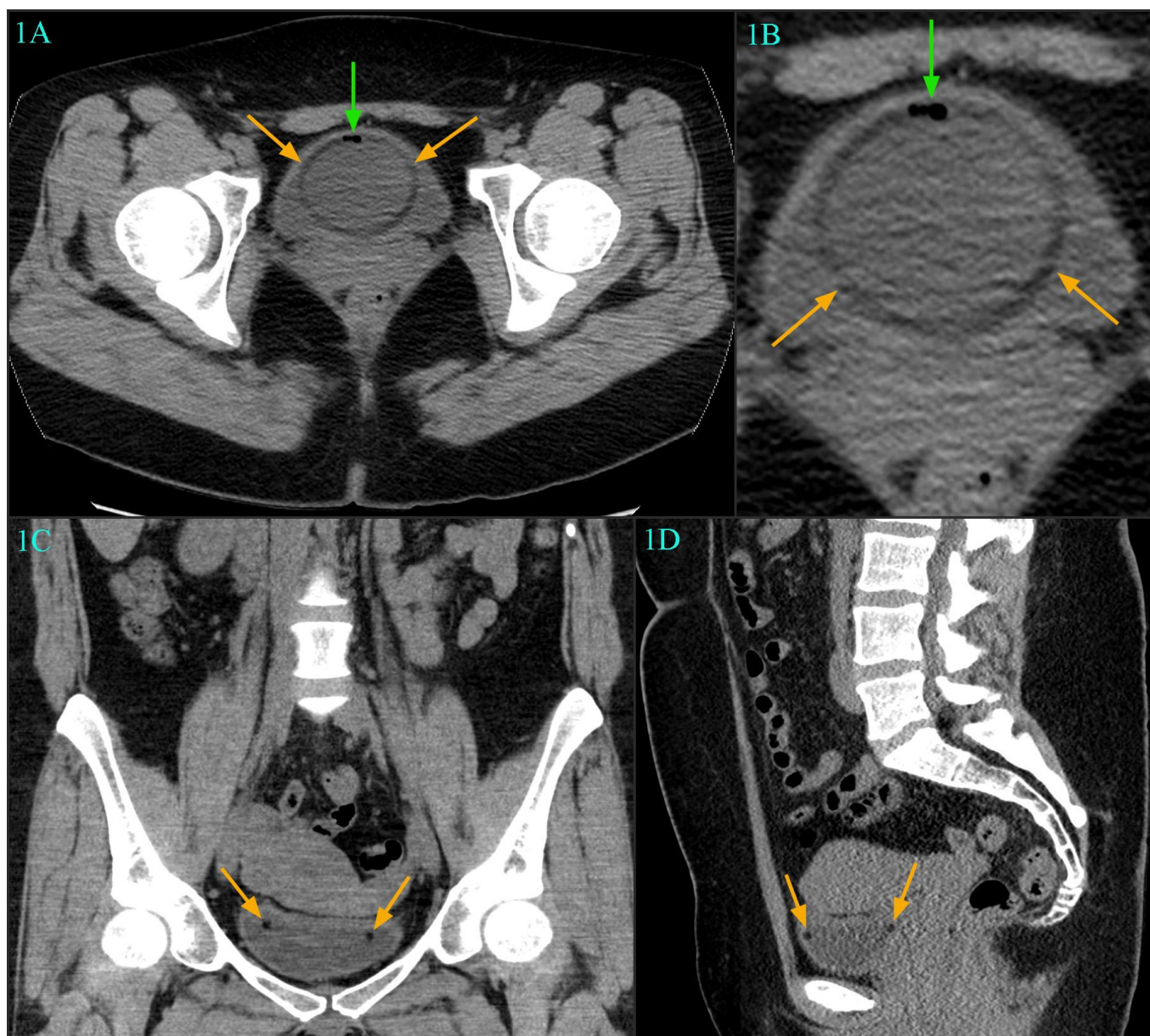


Figure 1: 31 year old female with intravesicular NuvaRing® placement.

Findings: Axial (figure 1A), magnification (figure 1B), coronal (figure 1C), and sagittal (figure 1D) images from a non-contrast pelvic CT demonstrated an intravesicular NuvaRing® as a circle of hypodensity (orange arrows) in a fluid-filled bladder. The ring measured 5.2 cm in diameter. An air locule is present within the ring (green arrows). The NuvaRing® is imaged in plane on the axial series (figures 1A and 1B) and in cross section on coronal and sagittal series (figures 1C and 1D, respectively), where 2 hypodense dots within the bladder (orange arrows) are seen. Note the empty, normal-appearing uterus posterior/superior to the bladder (best seen on figures 1C and 1D).

Technique: The CT scan was performed on a GE® 64-slice CT scanner using 120kV and variable mAs with 5 mm slice thickness. A standard soft tissue window (width of 350 Hounsfield Units (HU), center of 50 HU) was used for viewing. No intravenous contrast was used.

Etiology	Incorrect placement of NuvaRing® device by following a transurethral course
Incidence	Rare, only 3 other case reports according to our searches
Gender ratio	Essentially can only occur in females
Age predilection	Can occur in any age group, but more likely to involve reproductive age females since these patients would seek contraception or be affected by irregular menses, dysmenorrhea, and other menstrual related issues.
Risk factors	No established risk factors currently in the literature other than use of NuvaRing® itself
Treatment	Cystoscopic retrieval
Prognosis	Excellent
Findings on imaging	<ul style="list-style-type: none"> • Radiography- NuvaRing® will be seen as a radiolucent ring in the pelvis, but the ability to determine that the ring is intravesicular as opposed to intravaginal will be difficult. • CT- NuvaRing® will readily be demonstrated as a ring hypodense to surround urine. An air locule may be seen within the ring. Visualization in a contrast-filled bladder should be possible, but viewing window may need to be adjusted. • MRI- NuvaRing® is normally seen as a circular/ovoid structure with hypointensity on T1 and T2 weighted images. If incorrectly placed within the bladder, the ring will be better visualized on fluid weighted sequences due to improved contrast from the surrounding hyperintense urine. • Ultrasound- Bladder should be adequately distended for the examination. NuvaRing® will then be seen as a hyperechoic structure within a bladder filled with anechoic urine. Since the ring will usually be imaged in cross-section, 2 hypoechoic foci will typically be seen. • Scintigraphy- Due to the small thickness of the NuvaRing®, it will likely not be amenable to visualization on scintigraphy.

Table 1: Summary table for intravesicular NuvaRing® placement

Diagnosis	Radiography	CT	MRI
Intravesicular NuvaRing®	Radiolucent ring in the pelvis	Hypodense ring within the bladder, which may contain an air locule within the ring itself. In a contrast filled bladder, the NuvaRing® may be obscured by streak artifact, so window adjustment may be necessary to aid visualization.	Circular/ovoid structure with hypointensity on T1 and T2 weighted images within the urinary bladder. Fluid weighted sequences will improve visualization due to improved contrast from surrounding hyperintense urine.
Emphysematous cystitis	Gas locules will be seen within or immediately subjacent to the bladder wall.	Hypodense gas within or immediately subjacent to the bladder wall. Wall thickening and other inflammatory changes may also be seen about the bladder.	Significant susceptibility artifact about the bladder from intramural gas. Increased T2 signal may also be seen about the pelvis from inflammatory change.
Other intravesicular foreign bodies	Foreign bodies will be seen in the soft tissues of the pelvis, but again the ability to definitively characterize as intravesicular would be limited. Imaging appearance will also vary tremendously based on foreign body size, shape, and density.	Foreign body should be visible within the bladder, but the appearance of the object on CT will vary tremendously based on foreign body size, shape, and density.	Foreign body should be visible within the bladder, but the appearance of the object on MRI will vary tremendously based on foreign body size, shape, and density.

Table 2: Differential table for intravesicular NuvaRing®

ABBREVIATIONS

CT - computed tomography
EE - ethinyl estradiol
HPF - high power field
MRI - magnetic resonance imaging
HU - Hounsfield Units

KEYWORDS

Intravesicular foreign body; foreign body; contraceptive ring;
NuvaRing; contraception radiology; CT imaging

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