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Hydrosalpinx in patients with hysterectomy without salpingo-oophorectomy referred for pelvic magnetic resonance imaging

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ABSTRACT

Objective: Women with ovarian-sparing hysterectomy before 2007 are more likely to have retained Fallopian tube remnants which can become fluid-filled, distended masses, potentially mistaken for a cystic adnexal neoplasm on imaging. Here we assess the prevalence and appearance of hydrosalpinx in women with ovarian-sparing hysterectomy prior to 2007 referred for pelvic MRI.

Methods: A total of 3044 consecutive pelvic MRI exams performed over a two-year period (2003–2004) were selected from our radiology database and retrospectively reviewed. Examinations performed on male patients (N = 858), duplicate examinations on the same patient (N = 675) and examinations performed for MR guided biopsy (N = 1) were excluded from the study. From the remaining female pelvic MRI examinations (N = 1510), patients with hysterectomy without oophorectomy were identified. The frequency of hydrosalpinx in this population was then determined visually by two experienced radiologists and kappa analysis was then performed to assess for interobserver agreement.

Results: Of the 3044 pelvic MRI examinations, 1510 were performed on females and 76 (5%) of these women had ovarian-sparing hysterectomy. Of these 76 women, 14 patients (18%) had hydrosalpinx (kappa = 0.8) of which 11 were unilateral and 3 bilateral. A total of 9 of the 14 cases positive for hydrosalpinx in patients with ovarian-sparing hysterectomy were referred to MRI for evaluation of cystic adnexal masses detected on other modalities.

Conclusion: Hydrosalpinx should be considered in the differential diagnosis of cystic adnexal lesions in women with prior hysterectomy and retained ovaries.

1. Introduction

Hysterectomy with preservation of ovarian function is performed commonly, most often in premenopausal women for whom hysterectomy is medically indicated. Prior to 2007, many of these procedures were performed with retention of the majority of the Fallopian tubes since removal of the Fallopian tubes can incur increased procedural time, potentially with additional perioperative morbidity [1], and there have been reports that removal of the Fallopian tube may impair ovarian function [2,3]. However beginning around 2007, with the recognition that serous ovarian cancer may actually originate in the Fallopian tube [4–7], there was a practice shift towards removal of the Fallopian tubes when hysterectomy is performed with preservation of ovarian function [8,9] estimated at 371% increase in bilateral salpingectomy with hysterectomy between the period 2008–2013 [9].

However, despite this shift towards removal of the Fallopian tubes during ovarian-sparing hysterectomy, a large percentage of women do continue to retain their Fallopian tubes after hysterectomy. It was estimated that 15.8% of ovarian-sparing hysterectomies in 2013 underwent bilateral salpingectomy [9] and a recent study by Jones et al., reported that only 23% of the gynecologists surveyed understood the cancer risk-reduction associated with bilateral salpingectomy [10]. Therefore it is still important for radiologists to be aware of the potential of a dilated fluid-filled Fallopian tube remnant, or hydrosalpinx, as a potential complication of ovarian-sparing hysterectomy [11] since these cystic structures can be mistaken for a cystic adnexal neoplasm.

MRI can be useful in differentiating between these differential diagnostic possibilities [12,13]. Here we assess the prevalence of hydrosalpinx in women referred for pelvic MRI following ovarian-preserving hysterectomy prior to 2007, a time when Fallopian tube remnants were typically retained post-operatively. Defining the prevalence of this diagnostic entity in this population can aid awareness for the radiologist

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Table 1
Pelvic MRI protocol.

Sequence	Technique	Planes of imaging
T1-weighted spin echo	TR: 330–600 ms TE: 10–17 ms FOV 240 mm, SL:5 mm Matrix: 224–228 × 256–320	Axial
T2-weighted fast spin echo	TR: 2400–7000 ms TE: 85–126 ms FOV 240 mm, SL:5 mm Matrix: 224–228 × 256–320	Axial and sagittal
T2-weighted FS fast spin echo	TR: 2400–7000 ms TE: 85–126 ms FOV 240 mm, SL:5 mm Matrix: 224–228 × 256–320	Coronal
T1-weighted FS GRE pre- and post-IV contrast	TR: 150–367 ms TE: 2.3–2.9 ms FOV 240 mm, SL:5 mm Matrix: 224–228 × 256–320	Axial and sagittal

FS, fat-saturated; FOV, field-of-view; GRE, gradient echo; IV, intravenous: SL, slice thickness.

interpreting female pelvic MRI.

2. Methods

2.1. Patient selection

Approval was obtained from the institutional review board (IRB). A retrospective review of our imaging database revealed that a 3044 consecutive pelvic MRI examinations performed over a 2 year period extending from 2003 to 04. Examinations performed on males, for the purpose of MR-guided biopsy and duplicate examinations on the same patient were excluded from the study. The examination reports of the remaining female pelvic MRI were then reviewed and those with a total abdominal hysterectomy (TAH) without oophorectomy were selected for evaluation. The images associated with any reports that did not comment on the uterus and ovaries were reviewed visually for the presence or absence of these organs.

2.2. MRI imaging protocol

MRI examinations were performed on 1.5 T MRI scanners (General Electric Healthcare, Milwaukee, WI) using a female pelvis MRI protocol (Table 1) which consists of axial T1-weighted spin echo sequences (repetition time/echo time = 330–600/10–17 ms); axial, coronal and sagittal T2-weighted fast spin echo (2400–7000/85–126 ms) with fat-suppressed in the coronal plane; and axial and sagittal fat-suppressed T1-weighted out-of-phase spoiled gradient-echo (150–367/2.3–2.9 ms) pre and post-injection of intravenous gadolinium. The slice thickness was 5 mm, imaging matrix 224 - 228 × 256 - 320, field-of-view (FOV) 240 mm.

2.3. MRI imaging examination review

The MRI examinations of all patients with ovarian-sparing hysterectomy were reviewed by two board-certified radiologists with fellowship training in MRI, both blinded to the results of the clinical radiology report issued at the time of MRI examination. For each examination, both radiologists scored whether hydrosalpinx was present or absent within the left and right adnexal region on a scale of 1–5 as follows: 1 = no hydrosalpinx, 2 = unlikely hydrosalpinx, 3 = equivocal hydrosalpinx, 4 = probable hydrosalpinx, 5 = definite hydrosalpinx. For cases scored as “probable hydrosalpinx” or “definite hydrosalpinx” the laterality, right or left adnexal region, was noted. A true positive (score 4 or 5) or negative (score 1 or 2) was considered a consensus of the two readers. A kappa analysis was then performed utilizing the methods as described by Crewson et al. [14]). In addition to scoring the presence or absence of hydrosalpinx, the presence of peritoneal inclusion cysts was noted during the imaging review.

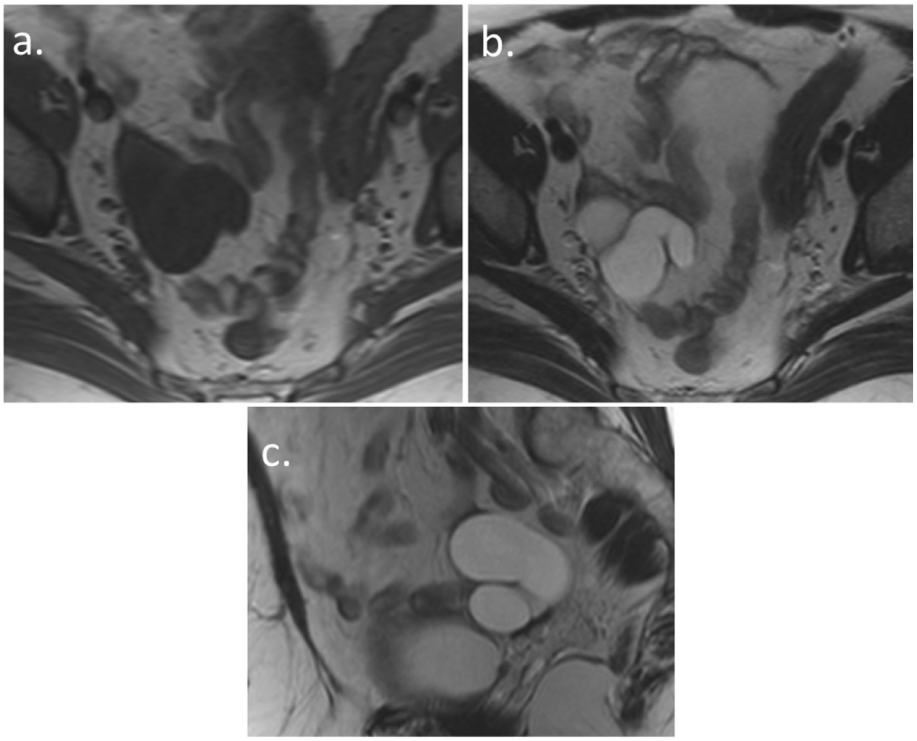

Fig. 1. Unilateral hydrosalpinx in a 63 year-old female status-post ovarian-sparing hysterectomy. (a) T1-weighted axial (b) T2-weighted axial and (c) T2-weighted right paramedian sagittal images reveal a tubular cystic structure in the right adnexal region adjacent to the ipsilateral ovary.

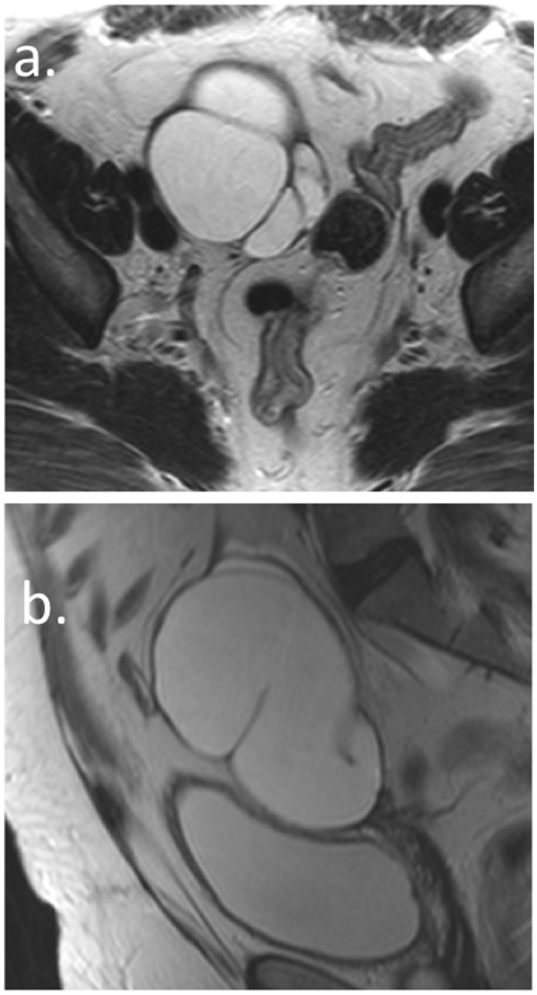

Fig. 2. Utility of multiple planes of T2-weighted imaging in the diagnosis of hydrosalpinx when evaluating a cystic adnexal lesion on MRI. (a) T2-weighted axial and (b) T2-weighted right paramedian sagittal reveal a tubular cystic structure in keeping with hydrosalpinx.

3. Results

3.1. Patient population

A retrospective review of our imaging database revealed that 3044 consecutive pelvic MRI examinations were performed during the study period. Those examinations performed on males (N = 858), for the purpose of MR-guided biopsy (N = 1) and duplicate examinations on the same patient (N = 675) were excluded from the study. Of these examinations, 1510 were performed on females of which 139 were status post-hysterectomy (9.2%). Of those women with hysterectomy, 76 (55%) women had retained ovaries. For patients status post-hysterectomy, the indications for pelvic MRI examination included pelvic mass, abnormal pelvic ultrasound, recently diagnosed malignancy, and pelvic pain.

3.2. Hydrosalpinx occurred commonly in patients referred for pelvic MRI with prior ovarian-sparing hysterectomy

Hydrosalpinx was identified as a tubular cystic structure adjacent to the ovary (Figs. 1 and 2) and the use of orthogonal planes of T2-weighted imaging, which is routinely acquired as part of the female pelvis MRI imaging protocol, was helpful in identifying the tubular nature of the dilated Fallopian tubes [15,16]. The prevalence of hydrosalpinx in patients with ovarian-sparing hysterectomy was 18% (14 of 76 patients; kappa score of 0.8). Of these patients with ovarian-sparing hysterectomy and evidence of hydrosalpinx, the prevalence of bilateral hydrosalpinges was 21% (3 of 14 patients; kappa value of 0.8). A total of 9 of the 14 women (64%) with ovarian-sparing hysterectomy who were positive for hydrosalpinx were referred for pelvic MRI for evaluation of adnexal lesions depicted on either sonography (3 exams) or CT (6 exams).

Peritoneal inclusion cysts were identified as loculated fluid collections around the ovary. The prevalence of peritoneal inclusion cysts in the ovarian-sparing hysterectomy patient population was 4% (3 of 76 patients).

4. Discussion

Patients with ovarian-sparing hysterectomy where Fallopian tube remnants are at an increased risk for post-operative hydrosalpinx [11,17,18]. Morse et al. [11] reported a statistically significant increase in hydrosalpinx in patients with history of prior tubal ligation followed by hysterectomy. Gregory [18] reported a case of bilateral hydrosalpinges in a patient after ovarian-sparing hysterectomy with history of prior tubal ligation. On pathology, there was closed loop obstruction of both Fallopian tubes as a result of lateral ligation from sterilization and medial transection from subsequent hysterectomy. The development of hydrosalpinx was hypothesized to be a result of tubal secretions into the closed loop obstructions.

In this study, we studied a population of women with ovarian-sparing hysterectomy performed at a time when salpingectomy was typically not performed. In a study of 425,180 girls and women who underwent hysterectomy in the United States by Hanley et al. [9], an estimated 2.3% of ovarian-sparing hysterectomies in 2007 were performed with salpingectomies. Therefore in our study population of women with ovarian-sparing hysterectomy referred for pelvic MRI, the majority of these patients can be expected to have retained Fallopian tube remnants. Our results show that pelvic MRI in these women manifest an 18% prevalence of hydrosalpinx, approximately one-fifth (21%) of which were bilateral, with a very strong interobserver agreement between the observing radiologists. This is higher than the reported prevalence of 6.9% hydrosalpinx on ultrasound [19] in this population, likely because of a study selection bias since patients undergoing pelvic MRI are likely to have had positive imaging findings leading to further evaluation on MRI. For example, in this study more than half of those with hydrosalpinx had been referred to MRI due to identification of an adnexal mass on another imaging modality.

The presence of hydrosalpinx in this patient population is likely a result of a close loop obstruction of the Fallopian tube, medially as a result of hysterectomy and laterally either as a result of tubal ligation, adhesions or other source of mechanical obstruction. Although surgical practices have changed such that many more women undergoing ovarian-sparing hysterectomy are also now having bilateral salpingectomy for cancer risk reduction, it is still important for radiologists to be aware of post-surgical complications inherent to retention of the Fallopian tube remnant. The findings from this study highlight the importance of considering the diagnosis of hydrosalpinx on pelvic MRI, particularly in patients who have undergone hysterectomy prior to 2007. There was also 4% prevalence of peritoneal inclusion cysts in patients with ovarian-sparing hysterectomy, a disease entity that is also associated with a history of prior surgery. This prevalence is in keeping with the reported literature of 2–6% prevalence of peritoneal inclusion cysts in patients with prior gynecologic surgery for adnexal masses [20,21].

In this study we utilized three planes of T2-weighed imaging to differentiate between a hydrosalpinx and a cystic ovarian lesion [22]. On axial T2-weighted images these disease entities may appear similar (Fig. 3a and b). However with multiple planes of imaging, the tubular configuration of a Fallopian tube will likely be depicted on one of the

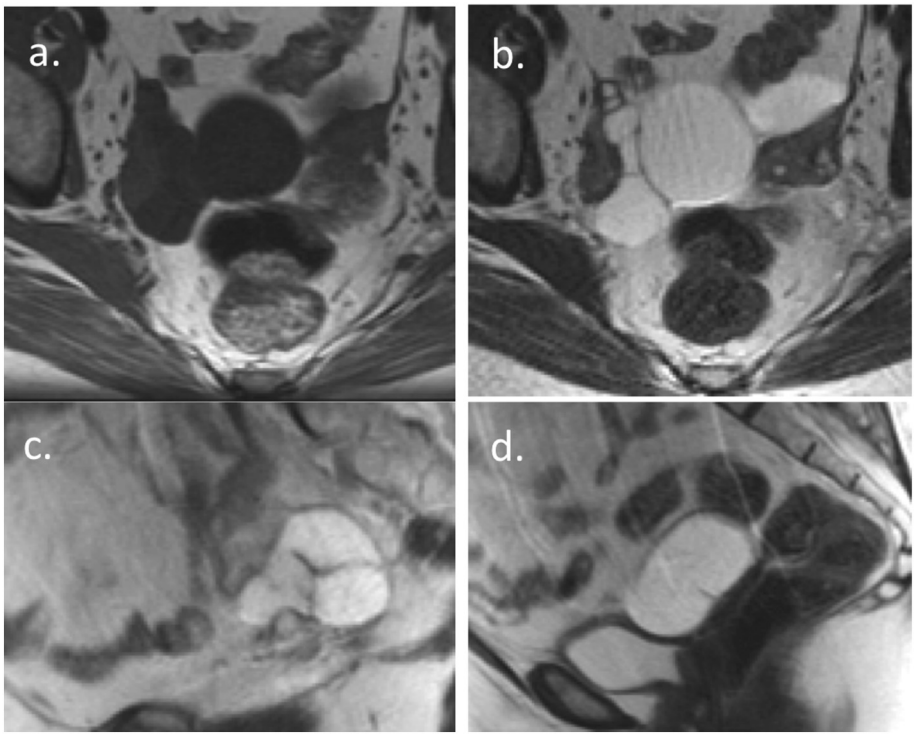

Fig. 3. Bilateral hydrosalpinges in a 54 year-old female with history of ovarian-sparing hysterectomy. (a) T1-weighted axial (b) T2-weighted axial (c) T2-weighted right paramedian sagittal and (d) left paramedian sagittal images reveal bilateral tubular cystic structures adjacent to the ipsilateral ovaries.

three routinely obtained orthogonal imaging an ovarian mass will usually remain rounded or ovoid in configuration on all planes of imaging. As such, we routinely employ three planes of T2-weighted imaging to be utilized in the evaluation of cystic adnexal lesions on MRI in imaging protocols of the female pelvis at our institution.

The limitations of this study include its retrospective nature and a lack of prior surgical history including whether salpingectomy had been performed with hysterectomy, hydrosalpinx was present prior to hysterectomy, tubal ligation was performed prior to hysterectomy or whether imaging findings correspond to pathologic findings of hydrosalpinx. Of note, Morse et al. did not see an increased risk of hydrosalpinx in patients with tubal sterilization followed by hysterectomy compared with tubal sterilization alone [23]. Rather, the diagnosis of hydrosalpinx was made based on the characteristic imaging appearance on MRI, which has been shown to be reliable for diagnosis of hydrosalpinx [12]. Finally, as mentioned above, there is a study patient bias which is illustrated by the fact that the majority of MRI exams positive for hydrosalpinx in this population of women with ovarian-sparing hysterectomy were referred for evaluation of a cystic adnexal lesion seen on another modality. Therefore, the 18% frequency of hydrosalpinx reported here is not likely to reflect the true prevalence of hydrosalpinx in general population of patients with ovarian-sparing hysterectomy without salpingectomy. Rather, our study describes the prevalence of hydrosalpinx in those patients being referred for pelvic MRI which is very relevant to the daily practice of a radiologist. It was not the goal of this study to compare the detection of hydrosalpinx on MRI with other imaging modalities such as ultrasound or computed tomography (CT), however this would be an interesting area of future study.

Our study does support consideration of hydrosalpinx in the differential diagnosis of a cystic adnexal lesion in patients with prior ovarian-sparing hysterectomy, particularly in those with hysterectomies performed prior to 2007. While the true prevalence of hydrosalpinx in this population is not known, the high rate of hydrosalpinx observed in those referred for MRI (18%) indicates that this is an important differential diagnostic consideration when interpreting female pelvic MRI in those who have had ovarian preserving hysterectomy. Though we did not specifically assess patient outcomes in this study, accurate recognition of this diagnosis on MRI by the interpreting radiologist may prevent unnecessary surgical intervention [24].

Conflict of interests

The authors have no disclosures.

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