CASE PRESENTATION
A 35-year-old Chinese woman, presented with a five-day history of right iliac fossa pain and mass, which was progressively increasing in size. She had no significant past medical history apart from laparoscopic tubal ligation performed years ago. Clinically, she was afebrile. Abdominal examination revealed a tubular, tender mass in the right iliac fossa. A bulky uterus and a right adnexal mass was found on vaginal examination. Urine pregnancy test was negative. What do the radiograph, ultrasonography (US) and computed tomography (CT) show (Figs. 1-3)? What is the diagnosis?
CT of the pelvis (Fig. 3) showed a rounded low-attenuation mass with an enhancing wall in the right adnexal region. The wall was thickened and it contained high-density objects within, causing streak artefacts. Mild inflammatory changes were also noted in the surrounding soft tissue and adjacent anterior abdominal wall.

**DIAGNOSIS**
Right-sided tubal ligation clips complicated by the formation of an infected retention cyst.

**CLINICAL COURSE**
The patient was treated with a course of intravenous antibiotics with resolution of her symptoms. Clinically, the mass was reduced in size. Repeat CT of the pelvis (Fig. 4) confirmed interval reduction in size of the right adnexal cyst and resolution of surrounding soft tissue inflammatory changes. Hysterosalpingography (HSG) was arranged to assess the position of the ligation clips and the patency of the fallopian tubes. It confirmed that the clips were laterally positioned at the ampulla of the fallopian tubes. No free spillage of contrast into the peritoneum was demonstrated to suggest failure of tubal ligation.

**DISCUSSION**
Female sterilisation is the most commonly-used contraceptive method worldwide. It is one of the safest operative procedures; complications are rare and occur in less than 1% of all female sterilisation procedures\(^1\). The common techniques for the interruption of tubal patency include the utilisation of mechanical devices, such as tubal rings and clips (e.g. Filshie, Hulka), and electrocoagulation. Ligation and excision are now less popular methods. The standard surgical approaches are laparoscopy, minilaparotomy and laparotomy usually performed at the time of a Caesarean delivery. Complications of female sterilisation can be categorised into perioperative and late complications.

Major intraoperative complications include mortality, visceral (such as bowel, urinary bladder and uterine) injury, vascular injury, infection and conversion from a laparoscopic procedure to a laparotomy. The risk of death is reported to be 1-2 cases per 100,000 procedures, most of which are complications of general anaesthesia\(^2\). Infection has an incidence of approximately 1%. Unintended laparotomy occurs with 1-2% of laparoscopic procedures, commonly attributable to technical difficulties; for example, adhesions from

**IMAGE INTERPRETATION**

Pelvic radiograph (Fig. 1) revealed two tubal ligation clips over the right hemipelvis and one on the left side. The clips appeared to be laterally positioned. Pelvic US (Fig. 2) demonstrated a rounded 6.5 cm × 5.6 cm × 4.9 cm cystic mass with homogeneous internal echoes. A brightly echogenic component was seen, measuring 1.6 cm × 1.3 cm × 0.8 cm.

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**Figs. 4a and b** Repeat CT images of the pelvis show interval reduction in size of the right adnexal cyst with resolution of surrounding inflammatory changes.

**Fig. 5** Hysterosalpingography shows the absence of opacification of the fallopian tubes beyond the sites of the ligation clips bilaterally. The clips are laterally positioned with the clips at the ampulla of the fallopian tubes. No free intraperitoneal spillage of contrast is demonstrated on either side.
previous surgery, rather than to complications of the procedure\(^{(2)}\).

The main and most essential late complication is tubal ligation failure, resulting in pregnancy, including ectopic pregnancy. Other complications are occasionally reported and include migration or expulsion of the tubal ligation clips, hydrosalpinx, tubal torsion and necrosis, late infection including abscess formation, and post-tubal ligation syndrome.

Tubal ligation is reported to have a failure rate of 0.1-0.8 % during the first year\(^{(3)}\). Common causes of sterilisation failure include an undiagnosed luteal phase pregnancy that was present at the time of sterilisation, surgical ligation of a structure other than the fallopian tube (most often, the round ligament), incomplete or inadequate occlusion of the tube, misplacement of the mechanical device and development of a tuboperitoneal fistula\(^{(4)}\). Given these causes, methods that can be used to reduce or prevent failures are by scheduling the procedure within the first 7-10 days of the start of the menstrual cycle, and meticulously identifying the fallopian tube by tracing the fimbrial end prior to occlusion. Ligation should be at the proximal tubal segment, approximately 2 cm from the uterine cornua\(^{(2)}\). The Collaborative Review of Sterilization (CREST), a large prospective study conducted in 16 teaching hospitals in the United States, enrolled 10,685 women who underwent sterilisation from 1978-1986, and followed them up until 1994. It reported a ten-year cumulative failure rate of 1.85% for all methods combined\(^{(4)}\). In addition, recent findings suggest that the risk of pregnancy persists for many years after sterilisation, and that the risk varies by method and patient’s age at sterilisation. The pregnancy rate was reported to be higher for women younger than 28 at the time of sterilisation than for women older than 34.

As the overall risk of sterilisation failure is low, the absolute risk of ectopic pregnancy is lower among sterilised women than among non-sterilised women. When a pregnancy does occur after sterilisation, however, at least one-third are ectopic pregnancies\(^{(5)}\). The CREST study reported a ten-year cumulative probability of less than 1% (7.3 ectopic pregnancies per 1,000 procedures) for all methods of female sterilisation combined\(^{(5)}\). This study also reported an association between ectopic pregnancy and the tubal occlusion method. The highest ten-year cumulative probability of ectopic pregnancy occurred among women who had undergone bipolar electrocoagulation (17.1 ectopic pregnancies per 1,000 procedures), while the lowest probability was found among women who had post-partum partial salpingectomy (1.5 ectopic pregnancies per 1,000 procedures)\(^{(6)}\).

Rare reports of migration of the ligation clips into the bladder, vagina, peritoneal cavity and appendix have been published, as have reports of expulsion from the vagina, urethra and rectum\(^{(6,7)}\). They are usually asymptomatic, but may present with acute or chronic abdominal pain. Hydrosalpinx, fallopian tubal torsion and necrosis can present with abdominal pain\(^{(8-10)}\). Post–tubal ligation syndrome, proposed in 1951, is a controversial constellation of symptoms, including pelvic discomfort, ovarian cystic changes, and menorrhagia, which are suggested to occur as a result of disruption of the utero-ovarian blood supply, with resultant disturbances of ovulatory function after sterilisation\(^{(11)}\). After extensive study, bilateral tubal ligation apparently causes few, if any, menstrual abnormalities within several years after sterilisation, regardless of the method of tubal occlusion used\(^{(11)}\).

When a female patient presents with abdominal pain, a thorough history-taking is essential and should include the obstetric and gynaecological history, including sterilisation. Radiographs of the abdomen should include the pelvis, as it is cheap, easy and of relatively low radiation risk. It allows visualisation and rough estimation of the positions of the tubal ligation clips, and excludes migration. As no ionising radiation is involved, US (transabdominal (TA) and transvaginal (TV)) is the modality of choice when obstetric or gynaecological causes are suspected. The uterus, adnexa (ovaries and fallopian tubes) and Pouch of Douglas are evaluated. It is however recognised that the ovaries may not be identifiable in some women\(^{(12)}\). The normal fallopian tubes are also not commonly identified. This region should be carefully surveyed for abnormalities, such as hydrosalpinx, adnexal mass and abscess. Metal ligation clips can be traced as brightly echogenic foci. The Pouch of Douglas should be assessed for presence of free fluid or mass. TA US offers an expanded view of the entire pelvis, including any mass that may lie beyond the endocervical probe, and shows the relationship of the internal structures with one another. Images of TV US are obtained from different orientations, and since its transducer is closer to the area being examined, improved visualisation of the female genital tract is achieved, in particular the adnexa. For example, TV US allows fairly accurate measurement of an ovarian cyst.

When the diagnosis remains a problem, CT can provide additional information as it shows different types of tissues with greater clarity, detail and differentiation. It also offers information on their


**Question 1:** Regarding female sterilisation:
- (a) It has a low complication rate of 1% and is hence considered safe.  
- (b) It has a better success rate in women younger than 35 years.  
- (c) Complications occur predominantly in both the perioperative and late stages of the procedure.  
- (d) Most of the pregnancies encountered are intrauterine rather than ectopic gestation.

**Question 2:** Complications of female sterilisation include:
- (a) Ectopic pregnancy.  
- (b) Hydrosalpinx.  
- (c) Tubal torsion and necrosis.  
- (d) Pseudocyst.

**Question 3:** Investigations of a female patient who has undergone sterilisation include:
- (a) A pelvic radiograph.  
- (b) An ultrasound examination.  
- (c) A radionuclide study.  
- (d) A micturating cystourethrogram.

**Question 4:** Regarding hysterosalpingogram:
- (a) It is the imaging modality of choice for the study of the fallopian tubes.  
- (b) Tubal patency is identified by tubal opacification and there is no peritoneal spillage.  
- (c) It can diagnose hydrosalpinx accurately.  
- (d) It is contraindicated in pelvic abscess.

**Question 5:** The following statements are true:
- (a) The ligation should be at the distal fallopian tube near the fimbrial end.  
- (b) Bipolar electrocoagulation has the highest rate of ectopic pregnancy among the various tubal occlusion methods.  
- (c) Ligature clip migration or expulsion usually cause symptoms needing surgery.  
- (d) HyCoSy (hysterosalpingo-contrast sonography) is an alternative method of studying tubal patency.

**Doctor's particulars:**
Name in full:__________________________________________  
MCR number:________________________________________  
Specialty:______________________________________________  
Email address:__________________________________________

**Submission instructions:**

A. Using this answer form
1. Photocopy this answer form.  
2. Indicate your responses by marking the “True” or “False” box.  
3. Fill in your professional particulars.  
4. Post the answer form to the SMJ at 2 College Road, Singapore 169850.

B. Electronic submission
1. Log on at the SMJ website: URL <http://www.sma.org.sg/cme/smj> and select the appropriate set of questions.  
2. Select your answers and provide your name, email address and MCR number. Click on ”Submit answers” to submit.

**Deadline for submission:** (July 2006 SMJ 3B CME programme): 12 noon, 25 August 2006

**Results:**
1. Answers will be published in the SMJ September 2006 issue.  
2. The MCR numbers of successful candidates will be posted online at http://www.sma.org.sg/cme/smj by 15 September 2006.  
3. All online submissions will receive an automatic email acknowledgment.  
4. Passing mark is 60%. No mark will be deducted for incorrect answers.  
5. The SMJ editorial office will submit the list of successful candidates to the Singapore Medical Council.