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Diagnostic tactics of hematocolpos following imperforate hymen mimicking a large ovarian cyst: A case report and a literature review

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ABSTRACT

Background: Imperforate hymen is a rare congenital defect of female genital tract resulting from the failure of embryologic canalization. This condition typically goes undiagnosed until menarche, when accumulated menstrual blood in the vagina leads to hematocolpos. Initial symptoms can include back pain, tenesmus, constipation, cyclic pelvic and abdominal pain, and difficulty urinating in conjunction with irregular menstruation.

Case presentation: This report presents a case of a 13-year-old female patient presenting with persistent lower abdominal pain without a history of menstruation. Initial transabdominal ultrasound due to its unspecific nature, suggested the presence of a large left ovarian cyst and a right ovarian cyst. Following the physical examination, MRI was performed in order to avoid misdiagnosis and to differentiate the mass. The MRI sequences depicted a right ovarian cyst and a dilated vaginal cavity with a hemorrhagic component (hematocolpos). Following the diagnosis, hymenotomy was performed with cross incisions and evacuation of 500 ml of hemolyzed brown blood was carried out. Post-operative ultrasound examination showed resolution of the space occupying mass which was previously mistaken as a left ovarian cyst.

Conclusion: This case study highlights the critical importance of a thorough physical examination and the use of MRI as a definitive secondary diagnostic tool when ultrasound findings are doubtful in young girls presenting with a pelvic mass and amenorrhea, to ensure prompt and accurate surgical management.

1. Introduction

Imperforate Hymen is defined as the presence of an intact hymenal membrane following failed spontaneous rupture. This results from failure of embryologic canalization of the most caudal portion of the vaginal plate at its junction with the urogenital sinus [1,2]. This rare congenital defect affects the female genital system and occurs in approximately 1 in every 2000 female births [1]. It is most commonly diagnosed in early adolescence with abdominal pain or a pelvic mass in the absence of menstruation [3].

Hematometra and hematocolpos refer to accumulation of blood in the uterus and vagina, respectively; on physical examination, hematocolpos may present as a bluish, bulging mass at the introitus. Menstrual blood collection in the vaginal or uterine cavity can lead to constipation, urine retention and acute renal failure [4,5].

Imperforate hymen is often overlooked due to its rarity. Therefore, a comprehensive physical examination is necessary. Pelvic ultrasound and MRI confirm the diagnosis of hematometrocolpos and identify any related abnormalities or consequences [6]. Treatment includes simple hymenotomy with proper incisions on imperforate hymenal membrane to provide an annular intact hymen [4]. Late detection of imperforate hymen can result in discomfort, infection, hydronephrosis, endometriosis, and infertility [5].

2. Case presentation

We are presenting a 13-year-old female patient who admitted to the Grodno Emergency Hospital due to a throbbing pain in the lower abdomen radiating to the lumbar region without nausea or vomiting.

According to the anamnesis, the pain appeared first and worsened over the following two days. She took spasmolytic at home to relieve the pain and noted a slight improvement. Thereafter due to the persistent pain she was taken to the emergency department of the central district hospital. Upon the admission in the district hospital, an ultrasound of

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the pelvic and abdominal organs was performed revealing a large left ovarian cyst and another right ovarian cyst.

Due to the persisting symptoms, the patient was transferred to the Grodno Emergency Hospital. The history depicted that the patient is sexually inactive and has not had her menstrual period yet. On examination she appeared phenotypically unremarkable with normal secondary sexual characteristics.

Transabdominal ultrasound of the pelvic organs was performed at the Emergency hospital. The right ovary revealed a two-chamber liquid formation of size 60 × 41 mm with non-uniform finely dispersed contents and fibrin strands. The left ovary presented with a liquid formation of size 128 × 102 × 118 mm and volume of approximately 575 ml with heterogeneous finely dispersed content. Abdominal palpation revealed a voluminous, tight, elastic formation of about 100–120 mm reaching the level of the umbilicus in the right lower abdomen. It was non-tender and could be palpated in all abdominal quadrants. Abdominal palpation did not indicate symptoms of peritoneal irritation. Following the physical and ultrasound examinations, diagnosis on admission was made as large left ovarian cyst with pain syndrome and right ovarian cyst. Afterwards the patient was given spasmolytic and referred to the gynecological ward for further examinations.

Examination of the external genitalia revealed an intact, bulging, bluish hymenal membrane at the introitus. The protrusion was slightly tense, moderately painful on palpation.

Thereafter magnetic resonance imaging (MRI) of the pelvic cavity was performed. In order to make the final diagnosis, the following MRI sequences were employed. (Figs. 1,2 and 3).

Thereafter, DWI and ADC was performed. Areas with reduced water diffusion will appear bright in diffusion weighted imaging. In contrast, places with unrestricted water diffusion, such as cysts, appear dark. On ADC maps, higher signal corresponds to increased diffusivity (free water), whereas low signal indicates restricted diffusion. Hemorrhagic products and fatty material can alter ADC and DWI signal depending on their stage and composition; interpretation requires correlation with T1/T2 appearances. Evaluation of the cervical canal, endometrial cavity, fallopian tube health, and endometriotic ovarian cysts is aided by DWI [9].

As for the conclusion of the above MRI sequences, T1W axial view, T2W coronal view and T2W sagittal SPAIR sequences depicted a sharply cystically dilated vaginal cavity filled with a hemorrhagic component, measuring 165 × 108 × 95 mm. Free fluid up to 4 mm thickness was detected in the rectouterine pouch. The left ovary was oval shaped, clear and smooth contours, measuring 17 × 33 × 18 mm, with multiple follicles. In the right ovary, against the background of follicles, a cystic formation with clear, even contours are determined, measuring 70 × 39 × 58 mm, without obvious signs of a pathology on diffusion-weighted imaging (DWI). The MRI concluded the signs of hematocolpos and cyst of the right ovary.

Following MRI examination, the final clinical diagnosis was confirmed as Imperforate Hymen with Hematocolpos and right ovarian cyst. Thereafter the patient was prepared for surgical perforation of the imperforate hymen. As for the pre-operative examination, patient was offered with laboratory examinations and the results were unremarkable with slight deviations.

Hymenotomy was performed under intravenous anesthesia after cleansing the external genitalia with antiseptic. A cruciate (cross-shaped) incision was made in the hymen, and approximately 500 ml of hemolyzed brown blood was evacuated. A sample of this menstrual blood was sent for a vaginal culture. Subsequently, introitus was digitally dilated and separate catgut sutures were applied to the edges. Concluding the procedure, a vaginoscopy was performed to visualize the cervix. It was noted that the vaginal mucosa was hyperemic and the integrity was not violated. The post-operative period was uneventful without any complications.

Post-operative transabdominal ultrasound of pelvic organs was performed. The right ovary revealed a liquid formation of size 41 × 22 × 40 mm with homogeneous content. The right ovarian cyst was considered a functional cyst related to menarche and will be monitored during follow-up. The left ovary did not reveal any space occupying lesions. 8 ml of free fluid was detected in the rectouterine

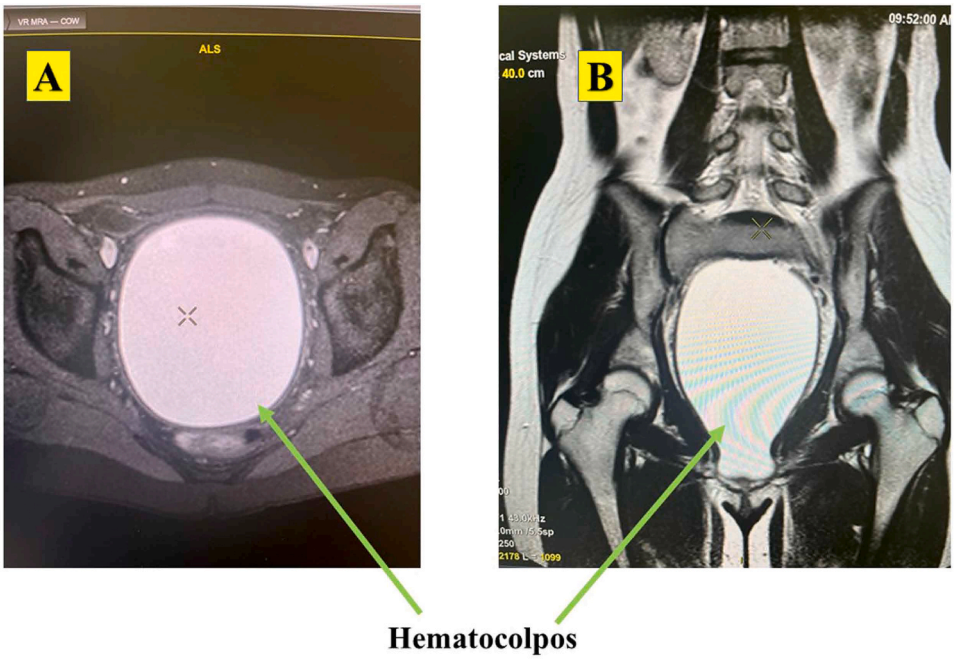

Fig. 1. (A) Axial T1 weighted image; (B). Coronal T2 weighted image of the pelvis. Conventional abdominal MRI protocols cover various T1-weighted (T1W) and T2-weighted (T2W) data collecting techniques [7]. Fig. 1: A and B images depicts the presence of a hyperintense mass in the pelvis. According to reports, T1 hyperintense regions are a useful indicator for differentiating between hemorrhagic masses [8]. In Fig. 1B shows a hyperintense mass which reach the margin of external genitalia. This could indicate the presence of either blood, pus or serous fluid. The condition of the uterus, cervical canal, vaginal canal, and the existence of any T2W hypointense septa in the uterus, cervix, or vagina are all revealed through true coronal images [9].

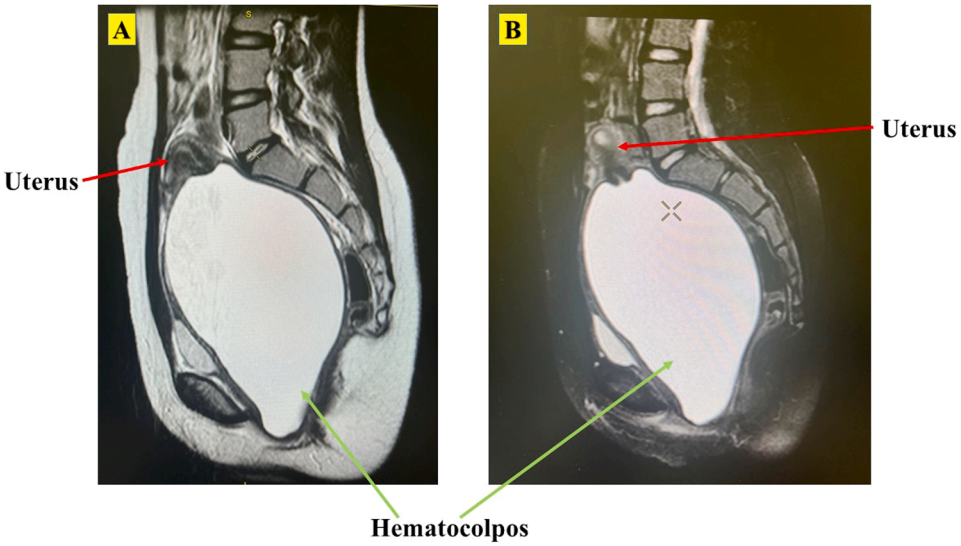

Fig. 2. (A) Sagittal T2 weighted image; (B) Sagittal T2 weighted SPAIR (Spectral Adiabatic Inversion Recovery) **sequence.** Fig. 2 shows T2 weighted sagittal view of the suspected mass. Fig. 2B includes an image with SPAIR sequence with fat suppression. SPAIR is a potent fat-suppression approach that outperforms traditional methods. Fat saturation on T2-weighted imaging is essential for illustrating edema or free fluid [7]. Due to the intrinsic frequency shift between fat and water, the SPAIR T2-MRI can suppress fat and clearly display pathological alterations on imaging [10].

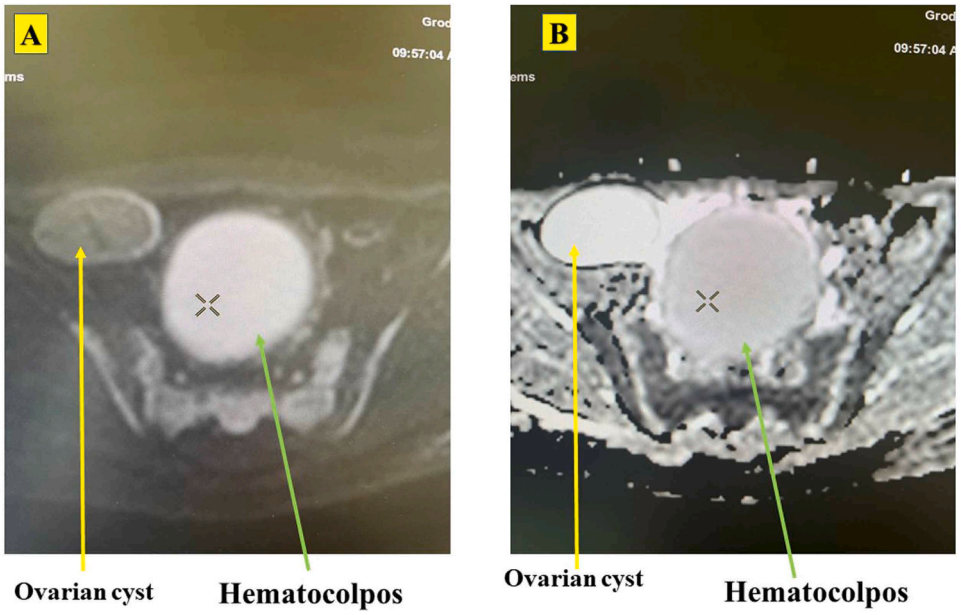

Fig. 3. (A) Axial DWI (Diffusion- weighted imaging) **image; (B) Axial ADC** (Apparent Diffusion Coefficient) **image**.

pouch. A detailed timeline of the patient's clinical course is presented in Fig. 4.

3. Discussion

According to literature, there are two possible causes of hematocolpos: acquired obstruction of the lower genital tract (labial adhesion, iatrogenic interventional operations) or congenital morphological defects (imperforate hymen, vaginal or cervical atresia, complete transverse vaginal septum) [11]. Although uncommon, imperforate hymen is an important congenital abnormality of the female genital tract [12]. The female genital tract develops during three weeks of embryogenesis through a number of steps including differentiation, migration, fusion, and canalization. Failure to complete these processes causes congenital hymenal and vaginal abnormalities. The structural disturbance disrupts vaginal function, potentially leading to problems and negative implications over time [12].

The vaginal introitus is surrounded by a thin layer of stratified squamous epithelium called hymen. An imperforate hymen is one that does not spontaneously rupture during newborn development. Hymen serves as a physical barrier to infection prior to puberty, while vaginal immunity is still developing [13].

Imperforate hymen is typically diagnosed after adolescence, causing abdominal pain, primary amenorrhea, or a pelvic mass. Complications of congenital abnormalities, such fetal hydrometrocolpos (HMC), can occur during the perinatal period. HMC is an uncommon condition that can be caused by cervical or endometrial mucus. Congenital vaginal blockage in later life can lead to infertility and endometriosis [14].

Patients with imperforate hymen are typically asymptomatic until menarche, making early diagnosis challenging [15]. At menarche,

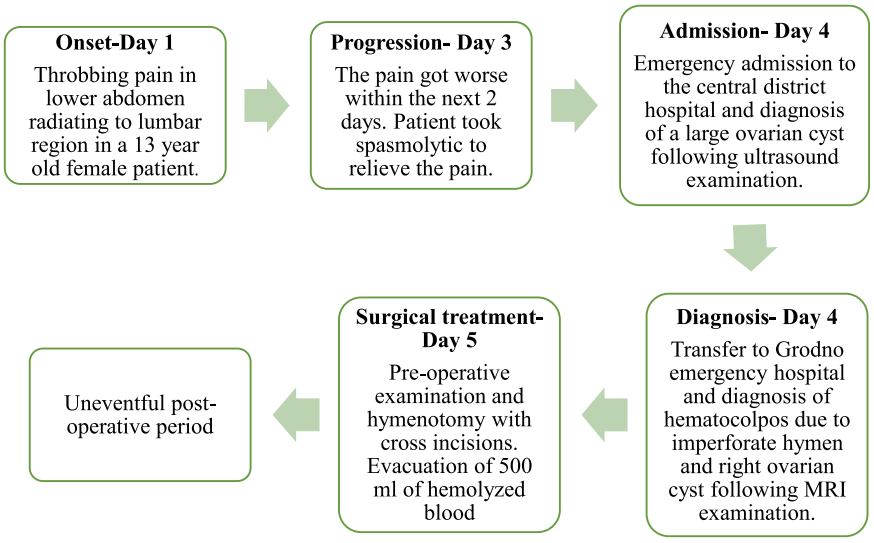

Fig. 4. Timeline of events.

females may have recurring abdominal and pelvic pain due to vaginal and uterine distension caused by menstrual blood accumulation. Compression of the urethra and bladder can cause obstructive uropathy symptoms, including urine retention and frequency [1]. A variety of symptoms, including primary or secondary amenorrhea, recurrent cyclical lower abdominal pain, a bluish bulge at the vaginal introitus, acute or chronic urine retention, mass per abdomen, endometriosis from retrograde menstruation, or intermittent constipation and intestinal obstruction, can also be caused by an imperforate hymen [13].

An imperforate hymen can be easily detected during a pelvic examination. Patients with hematocolpos show a bluish swelling hymen at the vaginal introitus. Ultrasound can be used to distinguish between pelvic cystic masses. MRI can uncover further conditions such cervical atresia, vaginal septum, and vaginal agenesis [15].

A pelvic MRI, which offers precise information about the architecture of the pelvis, is required for these patients primarily due to their youth. Furthermore, it depicts both the pathology and the anatomy of the urogenital tract, which is required in this situation [16].

Cervico-vaginal atresia, transverse vaginal septum, longitudinal vaginal septum, and imperforate hymen are among the several patterns of vaginal or uterine outflow system obstructions that can be identified using clinical, USG, and MRI scans [9].

To evaluate a pelvic mass, an MRI protocol should include sagittal and axial T1 and T2 pictures, along with coronal T2 imaging. Contrast must be administered as well. Better characterization of soft tissues is facilitated by the acquisition of T1 and T2 sequences in various planes. Fat saturation can also help with lesion characterization and distinguishing between hemorrhage and fat. By eliminating simultaneous anatomical differences, MRI also provides better visualization of the uterine anatomy. Additionally, coronal T2 scans enable kidney imaging, allowing for the exclusion of associated congenital abnormalities and anatomical variations [16].

In evaluating doubtful adnexal masses seen on ultrasound scan, MRI plays a pivotal role as a second level investigation method [17]. DWI and ADC mapping were initially proposed for radiologic diagnosis of neoplasms in the CNS and head and neck. Previously, it was thought that this may also be used in ovarian cystic tumors to distinguish between malignant fluid and benign cystic material [18]. Low signal in ADC indicates adipose tissue and blood components, which are major problems in DWI. Benign lesions with fibrotic content are characterized by poor signal at b1000 and ADC, as well as substantially hypointense tissue in the T2 weighted sequence (dark T2/dark DWI) [17].

According to Nakayama et al. [18], ADC values could distinguish between benign and malignant ovarian cystic tumors when mature cystic teratomas and endometrial cysts were included, but not when they were excluded. Furthermore, they stated that mature cystic teratomas displayed lower ADC values compared to other ovarian cystic tumors, likely due to the presence of keratinoid material. Endometrial cysts had modest ADC values, slightly higher than mature cystic teratomas, and were easily detected by conventional MRI [18].

In the above case we have discussed, the patient presented with the classic signs of imperforate hymen which are amenorrhea, throbbing pain and hymen completely covering the introitus. Vaginal examination also demonstrated a cyanotic hymenal bulging through vagina. Upon the ultrasound it was revealed that she was having a large ovarian cyst which later diagnosed as hematocolpos following the MRI. In this case we had a challenging situation while reaching a conclusion using the ultrasound examination results. Therefore, it was necessary to employ the MRI sequences to obtain a proper preoperative diagnosis. In this case we used T1W axial view, T2W coronal view and T2W SPAIR sequences confirm the hematocolpos while DWI and ADC mapping was employed to differentiate hematocolpos from ovarian cyst.

Following the preoperative diagnosis surgical perforation of the imperforate hymen was performed using cross incisions along with evacuation of accumulated blood. The cruciate (cross shaped) incision is found to have less risk for urethral damage during the procedure. Suturing the incised vaginal mucosa to produce a hymenal ring can be done after proper drainage and irrigation. Reclosure, vaginal adhesion, and vaginal adenosis are all possible consequences from this operation. Everting the edges of the incised vaginal mucosa can lessen the risk of recurrence [15].

Meutia et al. [3] explains about interdigitation of the Y-flap technique as a novel approach to comprehensive restoration of imperforate hymen. This approach forms a zigzag scar, reducing difficulties during recovery and resulting in favorable surgical outcomes.

Salleh et al. [19] discusses the incorporation of double cross plasty surgery to treat imperforate hymen. This technique may effectively manage vaginal restenosis in patients with transverse vaginal septum. Hymen preserving operations, like annular hymenotomy and simple vertical excision, are available for people who want to maintain their virginity [1]. Tables 1 and 2

According to the above summarize cases, abdominal or pelvic pain reveals the most common presenting complaint while, abdominal distention, urinary retention and constipation are also were also noticed. In majority of the cases, transabdominal ultrasound was used as the initial method of investigation and then proceeded with the MRI to

Table 1
Summary of similar cases.

Literature	Age (years)	Presenting complaints	Methods of investigation	Ultrasound findings	Method of surgical treatment	Amount of evacuated blood.
Jang et al. 2021 [15]	13	Periodic lower abdominal pain	Transabdominal ultrasound, MRI (T1 and T2 weighted images)	Hypoechoic pelvic mass below the bladder	Hymenotomy with cruciate incisions.	800 ml
Mo et al. 2022 [20]	14	Acute urinary retention and constipation	Transabdominal ultrasound, MRI	Large pelvic cystic lesion	Hymenotomy with cruciate incisions.	750 ml
Kumar et al. 2022 [1]	14	Gradually increasing abdominal swelling over a year, recent history of urgency and feeling of incomplete bladder emptying.	Transabdominal ultrasound, CT examination	Large cystic lesion with a thick echoic collection, extending from the epigastric region to the lower pelvis and posterior to the urinary bladder.	Hymenotomy	3000 ml
Biaye et al. 2019 [21]	14	Cyclical pelvic pain with cramps associated with primary amenorrhea	Transabdominal ultrasound	Hematocolpos and a hematometra measuring 180 × 90 mm	Hymenotomy with cruciate incisions.	600 ml
Agarwal et al. [22]	11	Progressive abdominal distention over a year	Transabdominal ultrasound	Huge cystic mass arising out of the pelvis with clear contents and no septa, papillae, or solid areas	Hymenotomy with cruciate incisions.	2000 ml
Amponsah-Manu et al. 2019 [23]	12	Progressively increasing epigastric and right lower quadrant pain	Accidental finding during appendectomy	Ultrasound was not performed since the initial diagnosis was appendicitis.	Hymenotomy with cruciate incisions.	500 ml
Tedyanto et al. 2024 [14]	11	Progressively worsening lower abdominal pain, symptoms of urinary retention and constipation	Transabdominal ultrasound	Huge hypoechoic fluid-filled mass in the vaginal lumen	Hymenotomy with cruciate incisions	600 ml
Agarwal et al. 2022 [13]	16	Primary amenorrhea with cyclical abdominal pain	MRI (T1 and T2 weighted images)	Ultrasound was not performed. MRI showed grossly distended vagina measuring 286 × 99 × 113 mm (cranio-caudal × antero-posterior × transverse) till the level of hymen, filled with T1 hyperintense and T2 hypointense fluid collections	Hymenotomy with cruciate incisions	3400 ml
Russell et al. 2021 [12]	13	Worsening migratory right iliac fossa pain.	Diagnostic laparoscopy	Imaging studies were not performed to avoid a delay in the definitive management since the initial clinical diagnosis was acute appendicitis.	Hymenotomy	800 ml
Bonello et al. 2021 [11]	13	Abdominal pain and constipation for 2 weeks	Transabdominal ultrasound	Huge echogenic fluid accumulation in the vagina (78 × 73 mm) suggestive of a hematocolpos	Hymenotomy with radial incisions	1500 ml

Table 2
Comparison of hematocolpos with differential diagnoses.

Condition	Clinical features	Physical exam	Imaging findings
Hematocolpos (Imperforate Hymen)- our case	Primary amenorrhea, cyclic pelvic pain	Bulging bluish hymenal membrane	Ultrasound- hematocolpos was revealed as a large cystic mass. MRI: distended vagina with blood products
Ovarian Cyst [31, 32]	Pelvic pain, menstrual irregularities, Constipation, Urinary retention	Adnexal tenderness and palpable mass	Ultrasound: cystic adnexal lesion; MRI confirms origin, surrounding structures and components of the cyst
MRKH Syndrome [28]	Primary amenorrhea, normal secondary sexual characteristics	Normal external genitalia; short, narrow vagina	MRI: Uterine remnants are visible
Megaureter [30]	Urinary symptoms, flank pain and tenderness	Abdominal distention	CT scan- large cystic abdominal mass

confirm the diagnosis

Is it necessary to perform a laparoscopic intervention to evacuate menstrual blood accumulated in the rectouterine pouch? In our case we noticed a free fluid accumulation of 4 mm thickness in the MRI which believe to be the menstrual blood spilled out of the fallopian tubes to the rectouterine pouch. Also, we drained 500 ml of blood from the hematocolpos but Agarwal et al. [13] discusses about a case where a 3400 ml of blood was drained from a hematocolpos. When dealing with a large-volume hematocolpos drainage, it's important to consider the accompanying problems. For instance, the evacuation of significant hematocolpos can lead to major difficulties. Patients should prepare for abdominal and perineal surgery beforehand. Before making an incision in the imperforate hymen, a rectoabdominal examination should be carried out to identify any concurrent hematometra or hematosalpinx [13].

In our case we were able to rule out hematometra and hematosalpinx through the MRI examination regardless of the insignificant amount of free fluid collected in the rectouterine pouch. The patient was managed and monitored subsequently. Decompression of the vagina can cause a hematosalpinx to tear from its adhesions to the parietal peritoneum, leading to intra-peritoneal bleeding. To ensure adequate drainage of the hematosalpinx or hematometra, perform a laparotomy before incision of the hymen if adnexal involvement is suspected [13].

Excessive uterine pressure can promote retrograde blood flow through the salpinx, potentially leading to endometriosis and tubal adhesions. In order to diagnose intra-abdominal issues such as ruptured salpinx, a laparoscopy could be required. However, needle aspiration of hematocolpos is not recommended due to the danger of infection and pyocolpos development [23].

Like in the case we have discussed above, simultaneous presentation of hematocolpos and an ovarian cyst give rise to a significant diagnostic

challenge because the abdominal distention cause by the hematocolpos often mimics a large adnexal mass. When a premenarchal or peripubertal girl appears with an abdominal mass, several differential diagnoses must be evaluated, including pregnancy, tuberculous peritonitis, ovarian cyst, megaureter, ectopic pelvic kidney with hydronephrosis, and imperforate hymen with hematocolpos. The absence of characteristic symptoms of cyclical lower abdomen discomfort, as well as a lack of preoperative pelvic examination and transrectal ultrasonography, can lead to an initial missed diagnosis [22]. Both obstructive congenital abnormalities and true adnexal pathology must be given priority in the differential diagnosis of an adolescent with primary amenorrhea and a pelvic mass [24].

According to our expertise we would like to discuss about three important differential diagnoses related to the above discussed case report. They are Ovarian cyst, Mayer-Rokitansky-Küster-Hauser (MRKH) syndrome and Megaureter.

In pediatric and adolescent patients, ovarian masses most often present with abdominal pain, a palpable mass, or abdominal distension. The pathological spectrum differs from adults, with germ cell tumors such as teratomas and dysgerminomas being the predominant neoplasms, followed by epithelial and sex-cord stromal tumors. Among benign lesions, cystic teratomas are the most common. High-resolution pelvic ultrasonography remains the cornerstone of diagnostic evaluation. Functional ovarian cysts, including follicular and corpus luteum types, may be physiological, while pathological cysts can cause intermittent pelvic pain, fullness, or a palpable mass. Acute pain is more suggestive of complications such as torsion or rupture. Imperforate hymen typically presents with primary amenorrhea, cyclic pelvic or back pain, a bluish bulging membrane at the introitus, and occasionally urinary retention or gastrointestinal symptoms [25–27].

MRKH syndrome is a congenital defect in the genital tract's embryonic development that causes primary amenorrhea in the presence of female secondary sexual characteristics. Although MRI is the gold standard for MRKH syndrome, ultrasonography is the first-line imaging technique for investigating the female pelvis. Cooper et al. [28] investigate one hundred and thirty-four patients with MRKH Syndrome. Ovarian cysts, including simple, hemorrhagic, para-ovarian, dermoid, and endometriomas, were identified in 12.6 % of cases. Women with MRKH syndrome and ovarian cysts may be more likely to develop pelvic pain. Ovarian tumors in women with MRKH syndrome are difficult to assess, especially if no vaginal reconstruction has been undertaken. The existence of ovarian tumors in MRKH syndrome patients complicates the entire diagnostic and therapy process. For women having gynecological problems, MRI provides a sensitive, non-invasive, and safe technique to guide future care [28].

A significantly dilated ureter also known as megaureter may resemble a cystic lesion in the pelvis, but thorough urinary tract imaging exposes its actual nature by revealing continuity with the bladder [29]. Jacob A. Clarke et al. [30] reported on a 16-year-old female with congenital giant megaureter syndrome. She had been experiencing abdominal distention, right flank pain, and soreness for the past five days. A massive cystic abdominal mass with no appreciably functioning left kidney was discovered using computerized tomography, resulting in subsequent compression of the contralateral right ureter. A left upper nephroureterectomy was performed, removing more than 3500 ml of fluid. Based on their experience, pediatric patients who present with a cystic abdominal mass should be evaluated for congenital giant megaureter.

Imperforate hymen, if left untreated, can lead to retrograde menstruation, endometriosis, infection, hydronephrosis, and renal failure. As a result, it is critical that this diagnosis is detected early [20].

4. Conclusion

The low incidence and peculiar symptoms of imperforate hymen can lead to misinterpretation during initial presentation. Therefore, suspicion of this condition should be raised in young teenage girls who exhibit cyclical stomach pain and amenorrhea. We highlight the importance of MRI scan in differentiating a large cyst and hematocolpos when the ultrasound diagnosis becomes doubtful. Prompt diagnosis of imperforate hymen and timely management can avert problems and preserve future fertility.

Ethical approval

The study was approved by the Institutional Ethics Committee

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CRediT authorship contribution statement

Kulasinghe Nethuki Akithma: Writing – review & editing, Writing – original draft, Data curation, Conceptualization. **Khvoryk Natallia:** Investigation, Methodology, Resources, Supervision.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper

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Data availability

Data will be made available on request.

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