An updated classification system of female genital tract malformations; changing the way we report.

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Learning objectives

1. To summarise the new 2013 classification system of female genital tract malformations, devised by European Society of Human Reproduction and Embryology (ESHR) and European Society of Gynaecological Endoscopy (ESGE).

2. Highlight changes, advantages and disadvantages of the ESHR/ESGE classification system with use of imaging examples.

3. Describe proposed structured reporting for classification of female genital tract anomalies according to the ESHR/ESGE guidelines.
**Background**

**Clinical relevance**

Female genital tract malformations affect approximately 7% \[i\] of women and may result in impaired fertility, recurrent miscarriage, amenorrhoea, dysmenorrhoea and pelvic malignancy. Appropriate classification of female genital tract malformations is essential, to guide appropriate clinical management and prevent unnecessary procedures. A recent systematic review highlights the higher prevalence of a septate uterus in infertile women and a higher prevalence of arcuate uteri in women with recurrent miscarriages \[ii\], thus diagnosing these is important as these patients may require surgery.

Other pathologies which may require surgical intervention include a rudimentary horn of a unicornuate / hemi-uterus with a functioning endometrium (due to risk of ectopic pregnancy and rupture \[ili\], didelphys/ bicorporeal uterus with vaginal obstruction and also vaginal atresia with a normal uterus. Such patients may present with amenorrhoea, haematometra or cyclical pelvic pain \[iii\].

**Embryology**

Traditional classification systems such as that produced by the American Society of Reproductive Medicine (formerly American Fertility Society) are primarily based on embryology, and therefore an understanding of the normal embryological development of the female genital tract is important.

During the 6\textsuperscript{th} to 11\textsuperscript{th} weeks of gestation the paired Mullerian (paramesonephric) ducts fuse to form the uterus, fallopian tubes, cervix and proximal 2/3\textsuperscript{rd} of the vagina. \textit{Fig. 1} on page 11 Female genital tract malformations or Mullerian duct anomalies result from the failure of development or failure of fusion. The upper part of the Mullerian ducts remain unfused to form the Fallopian tubes. Between 9-12 weeks a central uterovaginal septum is normally reabsorbed, however failure of this leads to a persisting uterine septum \textit{Fig. 2} on page 11. The ovaries and distal 1/3 of the vagina are formed from the primitive yolk sac and sinovaginal bud respectively, so anomalies of these are not usually associated.

Renal anomalies are commonly associated with female genital tract malformations in up to 30% cases \[iv\] \textit{Fig. 3} on page 12, \textit{Fig. 4} on page 13 and \textit{Fig. 5} on page 14. Although the aetiology for this is not well understood, it is thought to be related to possible genetic and familial factors \[v\] \[vi\] and the common origin of the urinary and genital systems from the embryonic mesoderm \[vii\].
At 6 weeks gestation the caudal end of mesonephric (Wolffian) ducts gives rise to ureteral buds (metanephric ducts) which grow cranially to form the ureters and pelvicalyceal systems. At the same time, the paired Mullerian (paramesonephric) ducts appear just lateral to the mesonephric ducts to grow caudomedially, crossing over the mesonephric ducts to meet the urogenital sinus by the 8th week. Invagination of the urogenital sinus forms the lower vagina.[iv]

Renal agenesis is the commonest association in up to 30% and is seen more commonly in uterus didelphys, most often ipsilateral to an obstructing, transverse, hemivaginal septum and in up to 40% of unicornuate uteri[vii]. Other associations include ectopic kidney, horseshoe kidney, renal dysplasia and duplex systems. Vertebral body anomalies are also associated[viii].

**Classification of female genital tract malformations**

The most widespread classification system is currently that produced by the American Society of Reproductive Medicine (formerly American Fertility Society - AFS) in 1998, summarised in Table 1 (below) and Fig. 6 on page 15. Whilst other classification systems have been suggested, these have not received widespread acceptance [xii] (Acien et al 2011 based on embryological origin [x] and Oppelt et. al 2005 VCUAM-vagina, uterus, adnexae and assoicated malformations [xi].) The AFS classification is widely accepted as it correlates well with pregnancy outcome. There are however several limitations of the AFS classification system, as described by Grimbizis and Campo (2010) [xii]

1. Uterine malformations form the basis of this classification system, however a separate classification for possible concomitant vaginal and cervical anomalies is not included. Clinicians may be faced with certain congenital anomalies which are not classifiable e.g. bicervical septate uterus with or without vaginal septum, didelphys with obstructing vaginal septum, bicornuate with vaginal/cervical dysplasia.

2. Uterine malformations are associated with a different prognosis to malformations of the cervix and vagina. Obstructive anomalies, for example cervical or vaginal anomalies with a normal uterus, are not represented in the AFS system and have a different clinical presentation to women without a functioning uterus, such as trapped menses, endometriosis, sexual and reproductive problems. Multiple combinations of uterine, vaginal and cervical anomalies are possible, and a clear and simple way of categorising these, which correlates well with patient management, is necessary.
3. There is debate regarding whether arcuate uteri and septate uteri should be classified separately.

4. The AFS Class I category is considered by some clinicians to be too general and not functional enough.

Table 1

The American Society of Reproductive Medicine (formerly American Fertility Society - [AFS]) Classification of Mullerian Duct Anomalies- 1998

<table>
<thead>
<tr>
<th>Class</th>
<th>Percentage of Mullerian Duct Anomalies (%)</th>
<th>Description [ix]</th>
<th>Embryology</th>
<th>Clinical relevance/management [iii] [viii]</th>
<th>Prevalence [i]</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>5-10</td>
<td>Mullerian agenesis or hypoplasia</td>
<td>Failure of development</td>
<td>No reproductive potential. Surgery if amenorrhea, hamatometra or pelvic pain.</td>
<td>9.4% infertile population have a hypoplastic uterus</td>
</tr>
<tr>
<td>I-A</td>
<td></td>
<td>Vaginal agenesis or hypoplasia (uterus normal/one or more variety of malformations)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I-B</td>
<td></td>
<td>Cervical agenesis or hypoplasia</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I-C</td>
<td></td>
<td>Fundal agenesis or hypoplasia</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class</td>
<td>No.</td>
<td>Description</td>
<td>Complications</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------</td>
<td>-----</td>
<td>-------------</td>
<td>---------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>10-20</td>
<td>Fallopian tube agenesis or hypoplasia</td>
<td>Combined agenesis or hypoplasia (two or more findings from classes IA to I-D)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>II-A</td>
<td></td>
<td>Complete/near complete arrested development of Mullerian ducts (MDs.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>II-B</td>
<td></td>
<td>6% infertile women</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>II-C</td>
<td></td>
<td>2.3% recurrent miscarriages.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>II-D</td>
<td></td>
<td>Surgery for II-A and II-B</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| III | 5-20 | **Uterus didelphys**  
Widely divergent horns and deep (>1cm) external fundal cleft; two separate communicating endometrial canals. Associated with longitudinal/transverse septum.  
Individual horns fully developed and normal in size. | Complete non-fusion of both Mullerian ducts.  
May consider metroplasty—however full term pregnancies have occurred.  
Vaginal obstruction complications may require surgery. | 2.9% infertile women  
0.8% recurrent miscarriages. |
| IV |  | **Bicornuate uterus**  
Partial non-fusion of MDs. | Rarely need surgery. | 10% infertile women  
5.3% recurrent miscarriages |
| IV-A |  | **Complete bicornuate uterus**  
Partial bicornuate uterus  
Central myometrium extends to internal |  |  |
| IV-B |  |  |  |  |
cervical os (bicorunate unicollis) or external os (bicorunate bicollis) with fundal cleft >1cm deep. Horns not as developed as didelphys.

<table>
<thead>
<tr>
<th>Type</th>
<th>Number</th>
<th>Description</th>
<th>Complications</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>55</td>
<td>Septate uterus</td>
<td>Failure of resorption of fibrous septum between two MDs.</td>
<td>Treatable with hysteroscopic resection of septum, can conceive after surgery. Fibrous septum-hysteroscopy. Muscular septum - may need transabdominal approach.</td>
</tr>
<tr>
<td>V-A</td>
<td></td>
<td>Complete septate uterus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>V-B</td>
<td></td>
<td>Partial septate uterus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VI</td>
<td>N/A</td>
<td>Arcuate uterus</td>
<td>Near complete resorption of septum.</td>
<td>Usually none unless recurrent fetal loss</td>
</tr>
</tbody>
</table>

46% infertile women
26.5% recurrent miscarriages

24% infertile women
of endometrium at uterine fundus. & No definitive depth established & 65% recurrent miscarriage \\

| VII  | DES-related uterine anomalies | In-utero exposure of DES (1945-70) increased risk of uterine malformations and clear cell carcinoma. & None & 46% infertile women \\
|      | T-shaped uterus               | Abnormalities of cervix associated. | 26% recurrent miscarriage |
|      | T-shaped uterus with dilated horns | | |

**Developing a new classification system- The ESHRE/ESGE consensus on the classification of female genital tract anomalies** [xii]

The European Society of Human Reproduction and Embryology (ESHRE) and European Society for Gynaecological Endoscopy established a common working group named CONUTA (CONgenital UTerine Anomalies) in order to devise an improved classification system. Data collected through questionnaires confirmed that a new classification system was felt to be necessary and should have the following attributes:-

1. A clear, accurate and user-friendly classification system.

2. **Anatomy** as the primary basis for the classification system, with the **uterus** as the key organ.

3. Embryological basis as a secondary characteristic.

4. Correlates well with patient management.
Benefits of the new ESHRE/ESGE classification system Fig. 7 on page 16

The newly devised ESHRE/ESGE classification system is summarised in the next section 'Findings and procedure details.' and in Fig. 7 on page 16.

**Class 0- 'normal uterus'** enables cervical (C) and vaginal (V) malformations to be classified independently.

Malformations are graded according to severity; U0-5, C0-4 and V0-4, with U5 being the most severe i.e. aplastic uterus.

**Class U3** incorporates "bicorporeal" fusion defects (didelphys and bicornuate) as this was considered a more functional mode of classification.

**Arcuate uterus** was not included separately, but this can be categorised into **Class U1c** Fig. 8 on page 17

**Class U6 - Unclassifiable** enable complex cases to be described.
Fig. 1

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Fig. 2: SEPTATE UTERUS- ESHRE/ESGE CLASS U2b. Axial T2-weighted MR image showing a complete septate uterus - U2b, previously AFS Class VA. The outer uterine fundal contour is maintained and the midline low T2 signal septum is clearly delineated. Septate uterus is associated with early pregnancy loss, and correct diagnosis and differentiation from bicorporeal uterus is important as these patients are eligible for hysteroscopic resection of the midline septum (metroplasty).

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Fig. 3: HEMI-UTERUS - ESHRE/ESGE CLASS U4, RIGHT RENAL AGENESIS AND ECTOPIC LEFT URETERIC INSERTION. Coronal post-intravenous contrast CT image. There is a hemi-uterus (black arrow), previously AFS Class II - unicornuate unicollis uterus. The left kidney has an ectopic ureteric insertion and is hydronephrotic (white arrow). There is also right renal agenesis.

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Fig. 4: HEMI-UTERUS - ESHRE/ESGE CLASS U4, RIGHT RENAL AGENESIS AND ECTOPIC LEFT URETERIC INSERTION. (Same patient as in Figure 3.) Coronal post-intravenous contrast MIP image. The left ectopic ureteric insertion (white arrow) and hydronephrosis is again visualised in this patient with a hemi-uterus (not visualised on this image slice.)

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Fig. 5: APLASIA OF UTERUS, CERVIX, OVARIES AND VAGINA WITH DUPLEX PELVIC KIDNEY- ESHRE/ESGE CLASS U5b,C4,V4. Axial T2-weighted MR image. The uterus, cervix and vagina are absent. Both ovaries are present. There is a duplex pelvic kidney with obstructed lower moiety (arrow). Previous AFS class IE (not as accurately classified.)

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Fig. 6

© American Fertility Society 1998
Fig. 7


Fig. 8: ARCUATE UTERUS- ESHRE/ESGE CLASS U1c. Single exposed HSG image showing an arcuate uterus, previous AFS Class IV. This cannot be distinguished from a septate uterus, class U2, on HSG alone as the external contour of the uterus is not visualised.

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Findings and procedure details

Imaging

Multimodality imaging is used in the characterisation of female genital tract malformations. Hysterosalpingography (HSG) and two-dimensional ultrasound (2D USS) are good initial screening methods but are limited in their ability to characterise the external uterine contour which is important in differentiating between different types of malformations. HSG cannot identify a non-communicating rudimentary horn of a unicornuate/ hemi-uterus and may fail to demonstrate a second cervical canal. Although it is generally a safe procedure, complications of HSG include haemorrhage, uterine perforation, pelvic inflammatory disease and allergic reaction to ionising contrast.[x]

Sonohysterography (SHG) or saline infused ultrasound may provide more information on the external uterine contour compared to HSG or USS alone [xi] and may be more tolerable than HSG [xii]

Three-dimensional (3D USS) has been shown to be accurate in classifying uterine anomalies [xiii] and has a high concordance with MRI in the diagnosis of uterine malformations [xiv] Fig. 9 on page 23.

Magnetic resonance imaging (MRI) is a very useful imaging modality due to its lack of ionising radiation and its ability to visualise the external contour of the uterus, thus enabling differentiation between a septate and bicorporeal uterus Fig. 2 on page 36 and Fig. 10 on page 24. Furthermore, MRI can also assess for concomitant renal anomalies.

We aim to illustrate some examples of congenital uterine anomalies and how they have been re-classified under the ESHRE/ESGE classification.

ESHRE/ESGE Classification of Congenital Uterine Anomalies [xii] Fig. 7 on page 22

Uterine Anomalies
Class U0- Normal Uterus Fig. 11 on page 25 Straight or curved interostial line, fundal midline indentation <50% uterine wall thickness.

5mm / absolute numbers avoided as this can vary between patients.

Class U1- Dysmorphic Uterus

Normal uterine outline but abnormal shape of uterine cavity excluding septa.

1a T-shaped- narrow uterine cavity, thickened lateral wall. 2/3 uterine corpus, 1/3 cervix.

1b Infantilis - narrow uterine cavity without lateral wall thickening, 1/3 uterine corpus, 2/3 cervix.

1c Others - Minor deformities of uterine cavity including minor indentation <50% uterine wall thickness at fundal midline (previous arcuate uterus Fig. 7) could be classified here

Class U2 Septate Uterus Fig. 2 on page 36 Fig. 9 on page 23 Fig. 12 on page 26 Fig. 13 on page 27 Fig. 14 on page 28

Normal fusion but abnormal absorption of midline septum. Normal uterine contour. Internal indentation at fundal midline >50% of uterine wall thickness (indentation=septum). Complete or partial septum which can extend cervix or vagina.

U2a Partial- septum partially dividing cavity above level of internal cervical os

U2b Complete - septum completely dividing uterine cavity up to internal os. Can or cannot have cervical or vaginal defects.

Class U3 Bicorporeal Uterus Fig. 10 on page 24 Fig. 15 on page 29 Fig. 17 on page 31

Abnormal fundal outline. External indentation at the fundal midline more than 50% of uterine wall thickness. All fusion defects.

U3a Partial- external fundal indentation partly dividing the uterine corpus above the level of the cervix.

U3b Complete - external fundal indentation completely dividing the uterine corpus above the level of the cervix.
U3c Bicornoreal septate uterus - absorption defect + fusion defect. Width of midline fundal indentation exceeds uterine wall thickness by 150%. +/- cervical/vaginal anomalies

**Class U4 Hemi-Uterus** Fig. 3 on page 37 Fig. 4 on page 38

All cases of unilateral formed uterus. Unilateral uterine development. Contralateral partially formed or absent. Classed separately from aplastic uterus (also a formation defect) as there is a fully developed functional hemi-uterine cavity.

**U4a** Hemi-uterus with rudimentary (functional) cavity. Communicating or non-communicating functional contralateral horn.

**U4b** Hemi-uterus without rudimentary (functional) cavity. Non-functional or absent contralateral part.

Recommend removal of rudimentary cavity (whether communicating or not) as can lead to ectopic pregnancy, haemato-cavity

**Class U5 - Aplastic Uterus** Fig. 5 on page 39 Fig. 18 on page 32 Fig. 19 on page 33 Fig. 20 on page 34 Fig. 21 on page 35

All cases of uterine aplasia. Formation defect, absence of any fully or unilaterally developed uterine cavity. Bi or unilateral rudimentary horn with cavity, or uterine remnants without cavity.

Usually co-existent vaginal defects e.g. vaginal aplasia - Mayer-Rokitansky-Kuster-Hauser syndrome.

**U5a** Aplastic with rudimentary (functional) cavity. Bi or unilateral functional horn

**U5b** Aplastic without rudimentary (functional) cavity. Uterine remanants or complete aplasia.

Presence of horn with cavity- necessary to identify complications.

**Class U6 - Unclassified cases**

Rarer or more subtle anomalies that are not classifiable to one of the other groups.

**Co -existent Cervical Anomalies** Fig. 17 on page 31 Fig. 20 on page 34
C0 Normal cervix

C1 Septate cervix. All absorption defects. Normal externally rounded cervix with septum.

C2 Double cervix. Cervical fusion defects. Two distinct externally rounded cervices- either fully divided or partially fused. E.g. former didelphys uterus - combined with complete bicorporeal uterus as class U3b/C2.


C4 Cervical aplasia and severe formation defects e.g. cervical cord, obstruction and fragmentation.

**Co-existent Vaginal Anomalies** Fig. 16 on page 30 Fig. 17 on page 31 Fig. 18 on page 32 Fig. 20 on page 34

V0 Normal vagina

V1 Longitudinal non-obstructing vaginal septum

V2 Longitudinal obstructing vaginal septum

V3 Transverse vaginal septum and/or imperforate hymen

V4 Vaginal aplasia, complete or partial.
Fig. 7

Fig. 8: ARCUATE UTERUS- ESHRE/ESGE CLASS U1c. Single exposed HSG image showing an arcuate uterus, previous AFS Class IV. This cannot be distinguished from a septate uterus, class U2, on HSG alone as the external contour of the uterus is not visualised.

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**Fig. 9:** SEPTATE UTERUS - COMPLETE TYPE. ESHRE/ESGE CLASS U2b. Previous AFS Class VA. 3D coronal ultrasound image. In 3D ultrasound coronal reformats can be obtained, allowing for more accurate evaluation of the outer fundal contour.

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Fig. 10: BICORPOREAL UTERUS- ESHRE/ESGE CLASS U3aC2V1. Formerly bicornuate uterus, AFS Class IV. Coronal T2-weighted MR image showing a partial bicorporeal uterus. There is a deep fundal external indentation that exceeds 50% of the uterine wall thickness and partially divides the uterine corpus (short arrow). There are also two cervices and there is a longitudinal vaginal septum (long arrow shows tampon within the right side of the vagina).

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Fig. 11: NORMAL UTERUS- ESHRE/ESGE U0. Sagittal T2-weighted MRI of a normal anteverted, pre-menopausal uterus.

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Fig. 12: SEPTATE UTERUS- ESHRE/ESGE U2b. Single exposed HSG image in a patient with a septate uterus, creating the impression of two widely divergent uterine cavities. HSG cannot distinguish between a septate uterus and a bicorporeal uterus as the outer uterine contour is not visualised. Please note Figures 2, 9 and 13 are of the same patient.

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Fig. 13: SEPTATE UTERUS- ESHRE/ESGE CLASS U2b. 2D axial transvaginal ultrasound image. A complete septum fully divides the uterine cavity, however on 2D ultrasound the appearances are of two separate uterine cavities. The diagnosis of septate uterus can only be confirmed on 3D US or MRI, where the outer fundal contour can be appreciated.

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**Fig. 14:** ENDOMETRIAL CARCINOMA WITHIN SEPTATE UTERUS. Axial T2-weighted MR image. There is a septate uterus. The left-sided uterine cavity is thickened and contains intermediate signal soft tissue. Biopsy confirmed the presence of grade 1 endometrial cancer with only superficial myometrial invasion - stage IA disease.

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**Fig. 15:** BICORPOREAL UTERUS (FORMERLY DIDELPHYS-TYPE) - ESHRE/ESGE CLASS U3bC2V1. Coronal T2-weighted MR image showing a complete bicorporeal uterus. Unlike Figure 2 the uterine cavities appear completely separate, without continuity of the myometrium. Two cervices are also noted and a possible vaginal septum (see Figure 12). Submucosal and intramural fibroids also noted.

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Fig. 16: VAGINAL SEPTUM. Axial T2-weighted MR image (Figure 15 and 16 are in the same patient). There is a thick longitudinal septation within the upper third vagina.

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Fig. 17: CLEAR CELL VAGINAL CARCINOMA WITH U3bC2V1 ANOMALY. Sagittal T2-weighted MR image. There is a bicorporeal uterus with complete separation of the uterine cavities (U3b) and there are two cervices (C2). There is a lobulated high signal soft tissue mass confined to the upper third of the vagina (arrow). Histology confirmed vaginal clear cell carcinoma.

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**Fig. 18:** APLASIA OF UTERUS, CERVIX, OVARIES AND VAGINA - ESHRE/ESGE CLASS U5bC4V4. Sagittal T2-weighted MR image. There is complete absence of the ovaries, uterus, cervix and vagina.

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Fig. 19: ANDROGEN INSENSITIVITY SYNDROME. Axial T2-weighted MR image in a patient with primary amenorrhoea and male chromosomes. The uterus, cervix and ovaries are absent, however the vagina is present - ESHRE/ESGE CLASS U5bV0. There are bilateral pelvic sidewall ovoid soft tissue masses with peripheral cysts (arrows), in keeping with intrapelvic testes. The patient was diagnosed with androgen insensitivity syndrome.

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Fig. 20: ATROPHIC UTERUS AND CERVIX + HAEMATOMETRA - ESHRE/ESGE CLASS U5bC4V3. Sagittal T1 fat-saturated image. The uterus and cervix are atrophic and the vagina is distended with subacute blood products (haematometra). V3 denotes the presence of a transverse vaginal septum or imperforate hymen.

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**Fig. 21**: SURGICAL NEOVAGINA. Sagittal T2-weighted MR image. There is a neovagina formed of small bowel (arrow).

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Fig. 2: SEPTATE UTERUS- ESHRE/ESGE CLASS U2b. Axial T2-weighted MR image showing a complete septate uterus - U2b, previously AFS Class VA. The outer uterine fundal contour is maintained and the midline low T2 signal septum is clearly delineated. Septate uterus is associated with early pregnancy loss, and correct diagnosis and differentiation from bicorporeal uterus is important as these patients are eligible for hysteroscopic resection of the midline septum (metroplasty).

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Fig. 4: HEMI-UTERUS - ESHRE/ESGE CLASS U4, RIGHT RENAL AGENESIS AND ECTOPIC LEFT URETERIC INSERTION. (Same patient as in Figure 3.) Coronal post-intravenous contrast MIP image. The left ectopic ureteric insertion (white arrow) and hydronephrosis is again visualised in this patient with a hemi-uterus (not visualised on this image slice.)

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Conclusion

Female genital tract malformations are an important cause of gynaecological symptoms, recurrent miscarriage and infertility. The new ESHR/ESGE classification system, based primarily on uterine anatomy, may result in a more functionally accurate and clinically applicable classification.
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