Pelvic ultrasonography in evaluating reproductive maturity in anorexia nervosa - a useful technique in clinical practice.

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Learning objectives

The aim of this exhibit is:

1. To review the changes occurring in the reproductive system caused by anorexia nervosa
2. To discuss the relationship between weight gain and degree of reproductive maturity and different parameters used to assess it
3. To explain the role of pelvic ultrasound in assessing the level of ovarian and uterine maturity in patients suffering from anorexia nervosa (in particular to review the grading system based on sonographic findings)

Background

Anorexia nervosa is a debilitating disorder which leads to a multitude of adaptive hormonal changes in all organs. The reproductive system is profoundly affected due to severe disturbance of the hypothalamic-pituitary-gonadal axis, resulting in hypogonadotrophic hypogonadism, leading to insufficient ovarian stimulation and ultimately decreased oestrogen production [1]. Due to hormonal imbalance the reproductive system either does not mature properly or regresses to its prepubertal status:

- the uterus decreases in size, loses its adult pear-shape and takes more of a teardrop-like configuration seen in prepubertal girls.
- the endometrium regresses and is either very thin or undetectable.
- the ovarian volume and number of follicles also decreases, ovarian immaturity is considered when ovarian volume in postmenarchal women decreases below 2ml.

With nutritional rehabilitation and maintained weight recovery, restoration of appropriate hormonal signalling and resultant maturation of the reproductive system is possible [2]. Healthy oestrogen levels have significant health benefits for ex. on bone and brain function and are a good marker of full biological recovery. Therefore, for clinicians treating the patients with anorexia nervosa, one of the main goals is to achieve sufficient weight gain to restore and maintain the maturity of the reproductive system.
Several ways of monitoring the progress in recovering the weight and the maturity of the reproductive system have been used [3, 4, 5]:

- target BMI,
- levels of oestrogen
- pelvic ultrasound examinations

Many studies have shown that target BMI and levels of oestrogen are not consistently reliable at predicting the maturation of the reproductive system and the onset of menstruation [5]. On the other hand, some have shown that pelvic sonography is a more objective and accurate way to target progress in anorexic patients [6].

In our exhibit we present the ways of performing the pelvic ultrasound and grading system to help evaluate the maturity of reproductive organs.

**Findings and procedure details**

Pelvic sonography is a very useful way of documenting the degree of immaturity of the reproductive system as it is:

- easily available,
- non-invasive
- non-ionizing
- can demonstrate well the morphology of the pelvic organs.

In anorexic patients the pelvic images should be obtained transabdominally with a full bladder. Transvaginal approach is not recommended due to the regression of reproductive system to prepubertal-like state or the fact that many of these patients have not started to be sexually active.

The following parameters should be recorded [7]:

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uterine length</td>
<td>Measured in the sagittal plane: the sum of 2 lengths:</td>
</tr>
</tbody>
</table>
the length taken from the fundus to the centre of the uterus at the inflection point and the length from the point of inflection to the external os of the cervix (Fig 1)

<table>
<thead>
<tr>
<th></th>
<th>Uterine configuration</th>
<th>Pear shape versus teardrop</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Uterine width</td>
<td>AP width</td>
</tr>
<tr>
<td>4</td>
<td>Endometrial thickness</td>
<td>Full thickness</td>
</tr>
<tr>
<td>5</td>
<td>Ovarian volume</td>
<td>$0.523 \times \text{length} \times \text{width} \times \text{depth}$</td>
</tr>
<tr>
<td>6</td>
<td>Number and distribution of follicles</td>
<td>Follicles in one plane $&gt;$2mm: multiple or few (Fig 2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Peripheral or scattered throughout ovarian parenchyma</td>
</tr>
<tr>
<td>7</td>
<td>Size of the largest follicle</td>
<td>If present</td>
</tr>
<tr>
<td>8</td>
<td>Density of stroma</td>
<td>Low or high echogenicity</td>
</tr>
</tbody>
</table>

**Uterus:** the assessment of the length and configuration are recommended as the first step to decide if the reproductive system is mature [7].

- If the length is $<$1cm, the uterus is considered immature, significant weight gain is mandatory
- If the length is $>$1cm, the further parameters should be assessed (i.d. endometrial thickness)

**Endometrium**

In very underweight patients the endometrium is undetectable or its thickness is $<$3mm (indicative of immaturity) [7]

- Endometrial thickness $>$3mm is indicative of a more advanced maturity but further assessment should be performed (ovarian appearance)
**Ovaries**

If not visualised, the scan should be repeated (the ovaries are either very small or obscured by overlying bowel gas) [7]

- If the ovaries are seen but their volume is <2cc, then they are immature; they may need more time to achieve maturity than the uterus
- If the ovaries are of normal size, then their maturity is determined based on the number, distribution and size of the follicles.

Based on the above sonographic parameters, the level of the maturity of the reproductive system can be graded. The following table presents the recommended grading system where grades 1-2 are considered immature, grade 3 is at the maturing stage and grades 4-5 represent a mature reproductive system [7].

<table>
<thead>
<tr>
<th>Grade</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Uterus</strong></td>
<td>Body smaller than cervix</td>
<td>Uterine body elongating</td>
<td>Uterine body width &gt;1cm</td>
<td>Uterine body becomes wider</td>
<td>Adult size</td>
</tr>
<tr>
<td><strong>Endometrium</strong></td>
<td>Undetectable</td>
<td>&lt;3mm</td>
<td>Variable</td>
<td>&gt;3mm</td>
<td>Dependent on the stage of menstrual cycle</td>
</tr>
</tbody>
</table>

- **Volume of ovaries**
  - <2ml
  - >2-4ml
  - 2-9ml
  - 2-9ml
  - 4-9ml

- **Follicles**
  - None/small
  - Small or multifollicular ovary
  - Multifollicular ovary
  - Small not multifollicular
  - Dependent on on the stage of menstrual cycle

<table>
<thead>
<tr>
<th>Reproductive system maturity</th>
<th>Immature</th>
<th>Maturing</th>
<th>Mature</th>
<th>Mature</th>
</tr>
</thead>
</table>

We present the ultrasound images of a 26 year woman with amenorrhoea referred to the Radiology Department by Eating Disorders Service. The level of maturity of her reproductive system, based on the sonographic parameters (uterine, endometrial and...
ovarian features), was graded as 3 (maturing stage). The clinicians were then able to use it as a motivational tool to show that the reproductive organs were not yet fully matured and the patient needed to gain more weight to progress to grade 4.

Images for this section:

![Ultrasound Image](image.png)

**Fig. 1:** 26 year old patient with anorexia nervosa and amenorrhoea. Uterine length: 4.3cm + 2.3cm.
Fig. 2: 26 year old patient with anorexia nervosa and amenorrhoea. Endometrial thickness: 2mm.

Fig. 3: 26 year old patient with anorexia nervosa and amenorrhoea. Ovarian volume: 6.69cc.
Fig. 4: Size of follicles. 12 tiny follicles have been identified in total in the left ovary. The follicles are scattered throughout the ovarian stroma. The stroma itself is unremarkable.
Conclusion

Reproductive maturity is a key indicator of a good recovery in patients with anorexia nervosa. Pelvic ultrasound is easy, reliable and gives clear information with regards to the patient’s reproductive maturity. Sonographic findings correlated with the population data help the clinicians assess how much weight the patient needs to gain in order to achieve reproductive maturity or progress between the different stages.

In our institution we have developed a dedicated service for the patients referred to Radiology Department by Eating Disorders Services where specially trained sonographers and radiologists perform the studies according to the accepted proforma.

Personal information

References


7. Mason HD, Key A, Allan R et al. Pelvic ultrasonography in anorexia nervosa: what the clinician should ask the radiologist and how to use the information provided. Eur Eat Disord Rev. 2007 Jan;15(1):35-41