Ultrasound and PCO

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Introduction

• Transvaginal U/S is currently the gold standard for the diagnosis of Polycystic Ovaries

• Incidence of PCOS: 4 – 10%

• Results of studies using ultrasound suggests a prevalence in young women of at least 20% (21 – 33 %)

• 5-10% of the women with the ultrasound picture will have the classic symptoms
• Considerable heterogeneity of symptoms & signs amongst women with PCOS

• These may change over time in an individual
Typical Ultrasound Findings

- Larger ovaries
- Multiple small peripheral follicles
- Increased echogenicity of stroma
- More spherical than ovoid shape
Ultrasound Criteria

- Ovarian Volume
  - $> 10\text{cm}^3$
- No of follicles 2 – 9mm
  - $> 10$
- Increased echogenecity of stroma
  - Present

- Atiomo et al 2000
3-D Ultrasound

• Dedicated volumetric probe

• Difference in ovarian size due to difference in stromal volume

• Not for general use!

Kyei-Mensah et al
Doppler Ultrasound

• Power doppler allows detection of blood flow in stroma –
  – but does not quantify the flow

• Colour doppler
  – ↑ PI in PCO
  – ↓ RI – positive correlation with LH-levels

• No significant differences in ovarian artery PI or RI when comparing PCO with normal ovaries
MRI

- Limited data
- Rarely used in clinical practice
- Does not provide more information than TVS
- Expensive
- Possibly in virgin or severely obese patients
Patients with Clinical PCO

• Common features:
  – Greater mean BMI
  – Higher s-total testosterone
  – Irregular cycles
  – Insulin resistance
What are more common in their ultrasounds?

- Number of small follicles
- Ovarian volume
- Stromal width / echogenicity
  - \textit{BUT}
    - Classic U/S features are not consistently present
Diagnosis

• How reliable is an ultrasound diagnosis of PCOS?
  – Prospective Observational Study
  – 18 patients with clinical & biochemical features of PCOS
  – 9 normal control patients
  – Single ultra-sonographer
  – 27 scans
• Scans video-recorded
• Rearranged to give 54 scans
• 4 Observers

**Diagnosis:**
- Normal
- Possible PCOS
- Definitely PCOS
Results

• Intra-observer agreement
  – 70%

• Inter-observer agreement
  – 50%
Conclusions

• Current used U/S criteria have significant variability and must be considered subjective
• Measurements too insensitive?
• Ultra-sonography alone may not be a reliable method of diagnosing or excluding PCOS

• Human Reprod June 2002
Number of follicles

- **PCOS Vs Control**
  - Higher number of follicles 2 – 5mm MFNPO
    - Significant correlation with androgens
  - Similar 6 – 9mm
    - Significant correlation with BMI & Fasting insulin

- **Proposal:**
  - Add to definition $\geq 12$ follicles in 2-9mm range mean of both ovaries
    - Sens – 75%, specificity – 99%
Ovarian Volume

- Mean ovarian volume is greater in patients with PCOS
- Use spherical formula: \( \frac{\pi}{6}(T+AP+Long) \)
- Association of total ovarian volume, pre-antral follicle number and total follicular number with some of the biochemical indices of PCOS, but none between ovarian stromal volume and these indices

– Human Reprod April 2002
Ovarian Stroma

- Stroma / total area had a sensitivity of 100% for diagnosis of PCOS and the most significant correlation with androgen levels
  - Fertility & Sterility Aug 2001

- Stromal index – ratio of mean stromal echogenicity to mean echogenicity of entire ovary

- SI – significantly greater in PCOS
  - Increased volume of stroma and
  - Lower mean echogenicity of entire ovary
  - Human Reprod March 1999
Stromal Area

- Correlated with levels of ASD and 17-OH-Progesterone
  - but not with
- Testosterone or LH or Insulin
Stromal Blood Flow

- Significantly higher in PCO
- Measurement is predictive of follicular response to ovarian stimulation
Effect on Fertility

- PCOS on ultrasound
- No symptoms
- Looked @ TTP, RR of sub-fertility
  - PCOS on U/S took longer TTP
  - Less fertile if:
    - Obese
    - Hirsuitism
    - Acne
    - Number of symptoms
Effect

- Obese (BMI >29)  \( RR = 2.6 \)
- Menstrual disturbances  \( RR = 4.6 \)
- Hirsuitism  \( RR = 2.5 \)
- Acne  \( RR = 2.7 \)

**Number of symptoms:**
- 2  3 – fold
- 3  7 – fold
- 4  10 – fold

**No symptoms:**
- no longer TTP
Conclusions

• Appearance of polycystic ovaries on U/S has no significant impact on fertility or fecundity in women with no symptoms.
• Appearances alone do not reflect pathological features.
• Obesity, menstrual disturbances and/or hyper-androgenism are associated with subfertility in these patients.

Fer & Ster October 2003
IVF

- PCO on U/S but no clinical symptomatology
  - More:
    - Follicles
    - Oocytes
    - Embryos
  - Same:
    - Fertilization
    - Cleavage
    - Miscarriage
• 69% higher chance of achieving pregnancy after 3 cycles
• 82% higher chance of achieving a live birth
Colour Doppler

- Quantification of doppler signal in ovarian stroma appeared to be greater in PCOS

- **Lower:**
  - Resistance index (↑ flow)
  - Pulsatility index
  - Vascularization Flow Index (VFI)
  - Flow Index (FI)

- **Higher:**
  - Vascularization Index (VI)
    - Significantly higher in patients with PCOS compared to normal ovaries
Correlations

• **Negative:**
  – Pulsatility index and LH
  – Pulsatility index and testosterone
  – Pulsatility index and LH/FSH ratio

• **Conclusions:**
  – Measurement of ovarian stromal blood flow by colour doppler may be of value in predicting outcome of treatment
Doppler Blood Flow

- May predict risk of ovarian hyper-stimulation during gonadotrophin therapy
- Requires specific expertise & machinery
- = not necessary as part of the diagnostic criteria for PCO
LOD

- Stromal Blood Flow measurement and the value of prediction of treatment outcome
- Prior & after LOD
- Colour doppler flow in stroma
- LH, FSH, Testosterone
- 6 – 10 weeks postop
  - LH and testosterone decreased $p<0.001$
  - Peak systolic velocity decreased $p<0.001$
  - Pulsatality index and resistance index increased $p<0.001$
LOD

- Long-term endocrine & ultra-sonographic outcomes:
- Ovarian volume
- LH, FSH, testosterone, ASD, SHBG

**Intervals:**
- Short < 1 yr
- Medium 1 – 3 yrs
- Long-term 4 – 9 yrs
Results & Conclusions

• Beneficial endocrine and morphological effects appeared to be sustained for up to 9 years

• Human Reprod Nov 2002
International Consensus
Definitions
Of
Ultrasound Assessment of the Polycystic Ovary
PCO

• Should have at least one of the following
  – $\geq 12$ follicles 2 – 9mm
  – Ovarian volume $>10\text{cm}^3$

• One ovary or single occurrence sufficient

• Not applicable to women taking pill

• Must have clinical symptoms
Technical Recommendations

• State of art equipment and trained people
• Transvaginal scan preferred
• When to scan?
  – Early follicular or random
• Dominant follicle or Corpus luteum – repeat scan in next cycle
• Ovarian volume calculation:
  – $0.5 \times (\text{length} \times \text{width} \times \text{thickness})$
• Follicle number & size
  – Measured in 3 sections
Clinical Diagnosis

• “Syndrome”
• 2/3 criteria
  – Oligo – and/or an-ovulation
  – Hyperandrogenism
    • Clinical or biochemical
  – Polycystic ovaries
    • Exclusion of other aetiologies
• Assess U/S features alongside appropriate endocrine, biochemical and metabolic tests as indicated by the presentation
• Ultrasound appearance of PCOs have limited predictive value for the endocrine parameters
• Inclusion of endocrine and biochemical criteria as diagnostic prerequisites of the syndrome is, therefore, necessary to reflect its pathological features
Thank you for your attention !!