

# Polycystic ovary syndrome - morphologic and dynamic evaluation by magnetic resonance imaging

Akademisk avhandling

Som för avläggande av medicine doktorsexamen vid Sahlgrenska akademien vid Göteborgs Universitet kommer att offentligen försvaras i Sahlgrenska aula, Sahlgrenska universitetssjukhuset, huvudentrén, Blå stråket 5, fredagen den 31 maj 2013, kl. 9:00

av

**Henrik Leonhardt**  
Legitimerad läkare

Fakultetsopponent:

**Professor Lennart Blomqvist**

Diagnostisk radiologi, Karolinska universitetssjukhuset, Solna / Karolinska institutet

Avhandlingen baseras på följande delarbeten:

- 1) Adipose tissue has aberrant morphology and function in PCOS: enlarged adipocytes and low serum adiponectin, but not circulating sex steroids, are strongly associated with insulin resistance**  
Mannerås-Holm L, Leonhardt H, Kullberg J, Jennische E, Odén A, Holm G, Hellström M, Lönn L, Olivecrona G, Stener-Victorin E, Lönn M.  
*J Clin Endocrinol Metab* 2011;96:304-11.
- 2) Uterine morphology and peristalsis in women with polycystic ovary syndrome**  
Leonhardt H, Gull B, Kishimoto K, Kataoka M, Nilsson L, Janson P O, Stener-Victorin E, Hellström M.  
*Acta Radiol* 2012;53(10):1195-201.
- 3) Ovarian volume and antral follicle count assessed by MRI and transvaginal ultrasonography; a methodological study**  
Leonhardt H, Gull B, Stener-Victorin E, Hellström M.  
*Submitted 2013.*
- 4) Antral follicle count and free testosterone, but not anti-Müllerian hormone, discriminate women with polycystic ovary syndrome from controls**  
Leonhardt H, Gull B, Lind A-K, Nilsson L, Janson P O, Hellström M, Stener-Victorin E.  
*Submitted 2013.*



UNIVERSITY OF GOTHENBURG

# Polycystic ovary syndrome - morphologic and dynamic evaluation by magnetic resonance imaging

Henrik Leonhardt, MD

Department of Radiology, Institute of Clinical Sciences,  
The Sahlgrenska Academy, University of Gothenburg, Sweden

## Abstract

Polycystic ovary syndrome (PCOS) is a complex endocrine disorder, affecting up to 15% of women of reproductive age. The syndrome is characterized by oligo-anovulation, hyperandrogenism and polycystic ovaries. What constitutes the best definition of PCOS is still a matter of debate. Women with PCOS have a higher risk of developing abdominal obesity, insulin resistance with progression to type 2 diabetes, hypertension, and endometrial hyperplasia/cancer. The etiology of PCOS remains incompletely understood, but insulin resistance may be central in the pathogenesis.

The main aims of this thesis were to: 1) characterize the distribution of abdominal adipose tissue in PCOS, 2) assess whether women with PCOS have altered uterine morphology or peristalsis, 3) compare transvaginal ultrasonography (TVUS) and magnetic resonance imaging (MRI) for estimation of ovarian volume and antral follicle count (AFC), and assess reproducibility and interobserver agreement of MRI measurements, and 4) investigate how well ovarian morphology and perfusion discriminate women with PCOS from controls and to elucidate associations between ovarian morphology and serum anti-Müllerian hormone (AMH), a potential surrogate for AFC.

Sixty women with PCOS and 31 age- and BMI-matched controls were recruited by advertising in the local community. There were no differences in abdominal volumes of total, subcutaneous and visceral adipose tissue, as determined by MRI, between the groups. The endometrium was thinner in PCOS with oligo-amenorrhea compared to controls. Based on cine MRI, uterine peristalsis was less commonly observed in women with PCOS than in controls. 2D MRI revealed more antral follicles, especially of small size, than 3D TVUS. Ovarian volume estimation by 3D MRI provided volumes closer to 2D TVUS values than did 2D MRI. AFC, ovarian volume, ovarian stroma volume, ovarian total cross-sectional area, AMH, and free testosterone differ in women with PCOS compared with controls. AFC and free testosterone are the best variables to distinguish women with PCOS from controls. AMH was not independently associated with PCOS.

In conclusion, women with PCOS display hyperandrogenemia, insulin resistance and adipose tissue abnormalities, although their abdominal adipose tissue distributions were indistinguishable from age/BMI-matched controls. A thinner rather than thicker endometrium was found in women with PCOS and oligo-amenorrhea as compared to controls, contrary to the general belief. Uterine peristalsis was less commonly observed in women with PCOS, but whether disturbed peristalsis contributes to infertility in PCOS remains to be investigated. Our findings suggest, when either oligo-anovulation or clinical signs of hyperandrogenism is absent, that AFC or free testosterone rather than AMH should be added in the estimation if a woman has PCOS or not. MRI had a high ability to distinguish and count small antral follicles, with an adequate intra- and interobserver reliability. MRI is a method well suited for scientific studies on this heterogeneous syndrome.

**Key words:** *polycystic ovary syndrome, PCOS, magnetic resonance imaging, MRI, ultrasonography, three-dimensional imaging, adrenal hyperplasia, body composition, uterine morphology, uterine peristalsis, ovarian morphology, ovarian perfusion, antral follicle count, AMH, diagnostic accuracy*