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Ovarian reserve and salpingectomy: Systematic review.

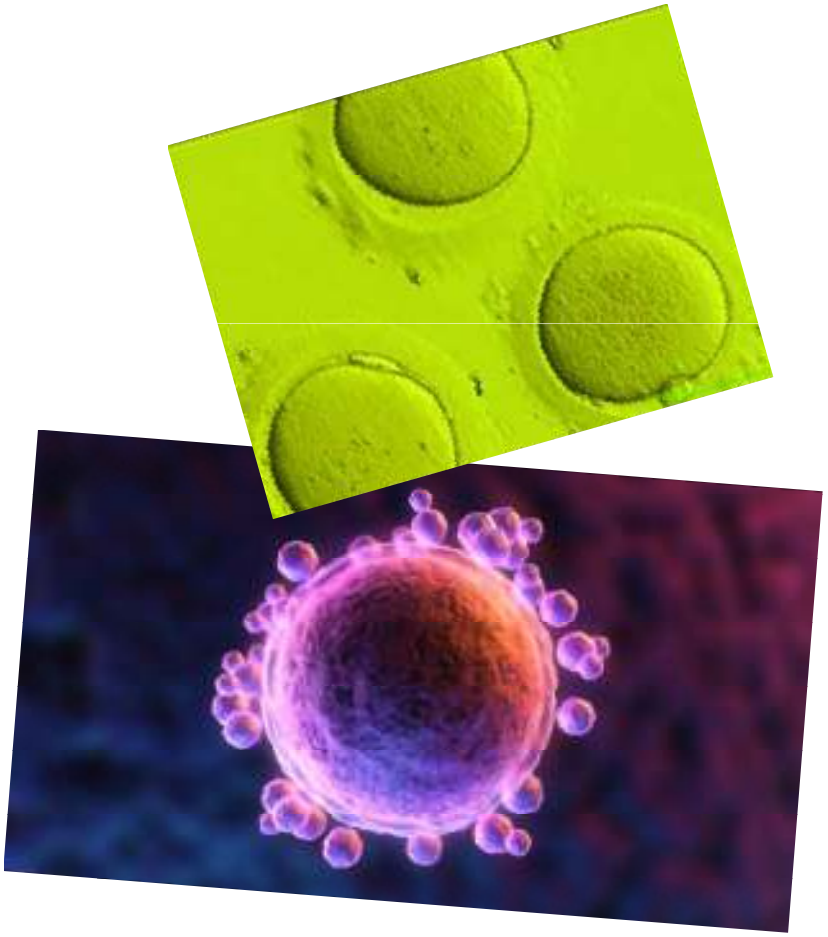
Dott.ssa S. Borgato

Ovarian reserve

Ovarian reserve : reproductive potential as a function of the **number** and **quality** of **remaining oocytes.**

decline with age, fertility varies significantly among women of a similar age

biochemical measures and ovarian imaging, collectively known as **ovarian reserve tests**, have been proposed to help predict ovarian reserve and/or reproductive potential



Ovarian reserve tests

biochemical tests

- **AMH** (antimullerian hormone);
- **FSH** (follicle-stimulating hormone);
- **ESTRADIOL**

ultrasound imaging of the ovaries

- **AFC** (antral follicle count)

FSH

Basal serum FSH concentrations **increase** on day 2, 3, or 4 of the menstrual cycle **with advancing reproductive age**

intra-cycle variability

consistently elevated FSH concentrations confer a poor prognosis

a single FSH value has very limited reliability

E2

poor inter- and intra-cycle reliability

The vast majority of studies have found that basal estradiol does not differ between women with and without DOR

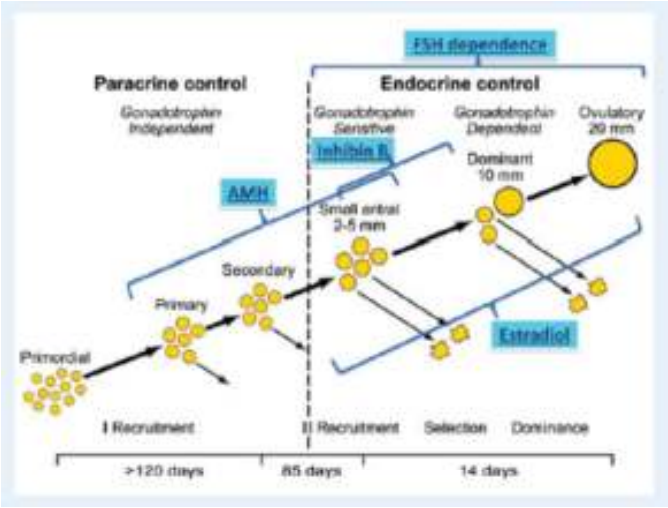
Basal estradiol alone should not be used to screen for DOR

only as an aid to **correct interpretation of a "normal" basal serum FSH value.**

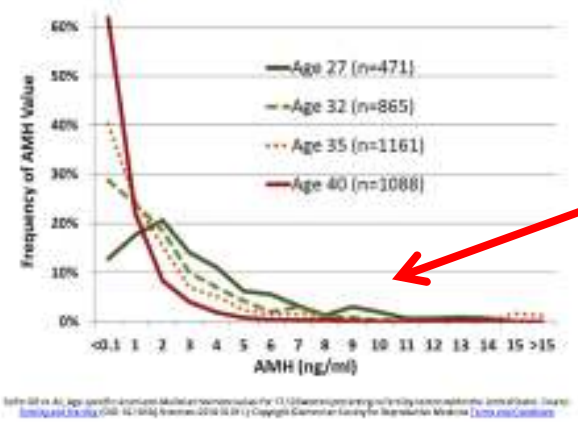
the best currently available test in terms of sensitivity and specificity

AMH

Glycoprotein hormones primarily secreted by granulosa cells of **primary, preantral, and antral follicles**.



size of the pool of antral follicles, representing the quantity of the remaining primordial follicles



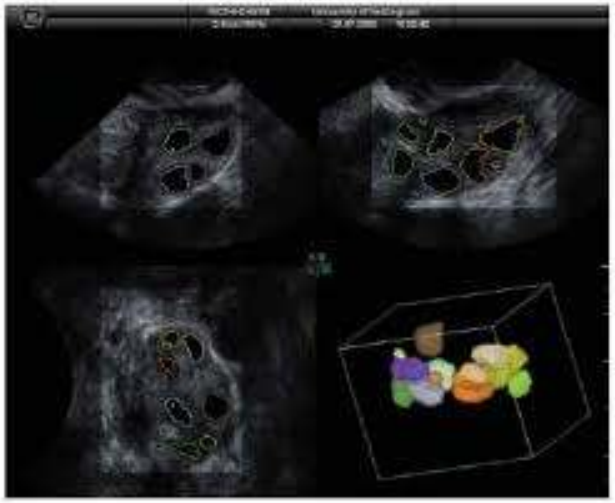
After an initial increase until early adulthood, **AMH concentrations slowly decrease with increasing age** until becoming undetectable 5 years before menopause when the stock of primordial follicles is exhausted.

AFC

Antral follicle count is the **sum of antral follicles in both ovaries**, as observed with transvaginal ultrasonography during the early follicular phase.

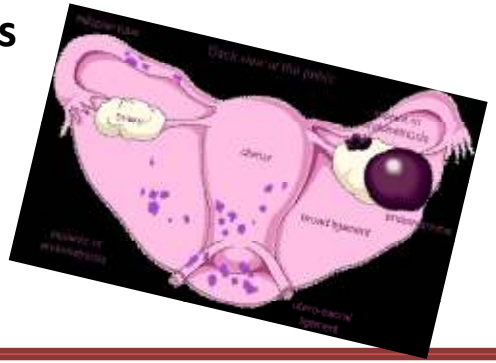
- Most studies have defined antral follicles as those measuring **2–10 mm** in mean diameter in the greatest two-dimensional (2D) plane;
- some have defined antral follicles as those measuring **3–8 mm** in mean diameter.

good inter-cycle reliability and Interobserver reliability in experienced centers



RO

1. Advanced age (>35)
2. Family history of early menopause
3. Past chemotherapy
4. Past radiotheraphy
5. History of pelvic surgery
6. History of pelvic infection or tubal diseased
7. History of severe endometriosis
8. Smoking



How surgery reduced RO?

activation of inflammatory process

- Thermal damage: electrical devices used during surgery increased local temperature wich produced injury to surrounding tissues by thermal diffusion

- Damage to blood vessels in the mesosalpinx: median ovarian artery is closed to medial tubal artery at their origins so injudicious surgery can jeopardize ovarian artery supply

Disrupt follicolar development

Effect of laparoscopic excision of endometriomas on ovarian reserve: serial changes in the serum antimüllerian hormone levels

Hale Goksever Celik, M.D.,[a] Erbil Dogan, M.D.,[b] Emre Okyay, M.D.,[b] Caginur Ulukus, M.D.,[c] Bahadir Saatli, M.D.,[b] Sezer Uysal, M.D.,[a] and Mikail Kosyurucuoglu, M.D.[a]

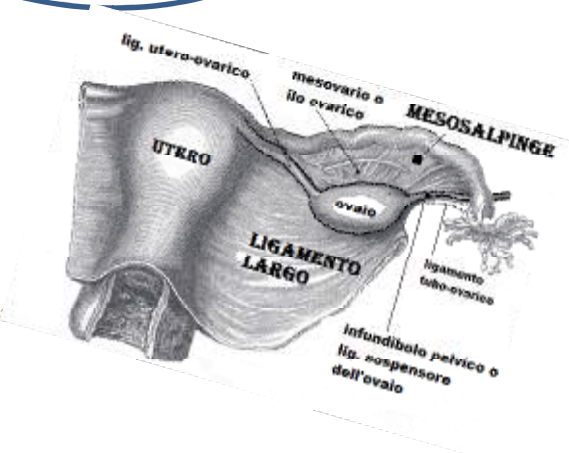
[a]Department of Pathology,

Mol Med Rep. 2015 Aug;12(2):2985-90. doi: 10.3892/mmr.2015.3677. Epub 2015 Apr 24.

Inflammatory cytokine expression following the use of bipolar electrocoagulation, ultracision harmonic sc and cold knife biopsy.

Litta P[1], Saccardi C[1], Gizzo S[1], Conte L[1], Ambrosi G[2], Sissi C[2], Palumbo M[2].

Author information



In our experience several patients, also young, underwent unilateral or bilateral salpingectomy before IVF

Does salpingectomy **affect the ovarian reserve** and the **ovarian response to gonadotropin** during in vitro fertilization – embryo transfer cycles

Aim of the Review

Evaluate the influence of unilateral or bilateral salpingectomy to ovarian reserve and the subsequent in vitro fertilization

effect of salpingectomy on serum antiMullerian hormone level

effect of salpingectomy on Antral follicle count

Evaluate the effect of salpingectomy on ovarian response in controlled ovarian hyperstimulatuion

Data Sources

- **Interval time from 1998 to 2015**

- **Key search terms:**

- Salpingectomy and OR
- Salpingectomy and AMH
- Salpingectomy and AFC
- Salpingectomy and ART
- Salpingectomy and IVF

- **Outcomes**

- AMH/AFC before and after unilateral or bilateral salpingectomy
- AMH/AFC after salpingectomy vs infertil women
- IVF outcome before and after salpingectomy in infertil women

Available Methods

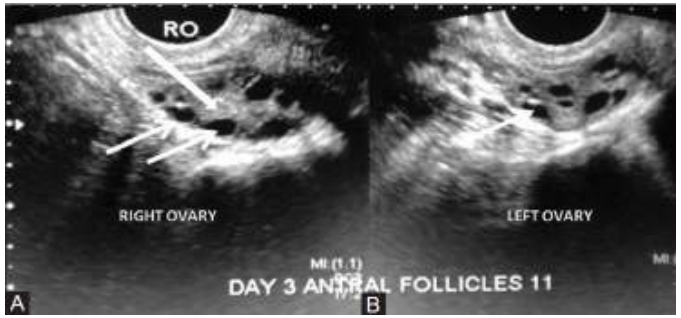
Study group: unilateral or bilateral laparotomic or laparoscopic salpingectomy

Ectopic pregnancy

Hydrosalpinx

Control group:
- **same group before surgery**
- **non operated ovary**
- **non surgical group**

AFC antral follicle count



AMH serum antiMullerian hormone level

Results

Effect of salpingectomy on ovarian reserve and subsequent IVF

Authors & Years	Type of Study	Patients (total)	Patients (Salpingectomy)	Patients-Controls (No surgery)	Age (year ± SD)	BMI (± SD)	Indication for Surgery	Years from Surgery	Reason of Infertility	Duration of Infertility (year ± SD)
Lass et al 1998	P	102	a) 29 unilateral not specified	b) 73 no surgery	a) 33.1 ± 4.9 b) 34.2 ± 4.1	n.s	a) ECP	2	a, b) MF (31) Unexplained (42)	2 years after surgery
Tal et al 2002	P	78	a) 26 unilateral (14 LPT, 12 LPS)	b) 52 no surgery	a) 32.1 ± 4.1 b) 32.0 ± 5.1	n.s	a) ECP	1-9	n.s	n.s
Chan et al 2003	R	32	a) 18 unilateral LPS b) 14 unilateral LPT	Controls: non-operated site	a) 34 (31-38) b) 36 (33-44)	a) 20.96 b) 21.44	a, b) ECP	At least 3 months	n.s	n.s
Gelbaya et al 2006	R	168	a) 40 salpingectomy - 16 unilateral - 24 bilateral b) 25 tubal division - 9 unilateral - 16 bilateral LPS	c) 103 no surgery	a) 32.8 ±3.57 b) 33.1 ±2.71 c) 33.5 ±3.32	n.s	a, b) HY	n.s	a) TF & MF 2/40 TF & OF 4/40 TF & END 2/40 b) TF & MF 5/25 TF & OF 5/25 TF & END 1/25 c) TF & MF 12/103 TF & OF 9/103 TF &END 5/103	n.s
Orvieto et al 2011	R	15	a) 15 uni/bilateral not specified	Controls: same patients before surgery	32 ± 4.4	24 ± 5.5	a) HY	n.s	n.s	n.s
Xi et al 2012	R	156	a) 76 salpingectomy - 32 bilateral - 44 unilateral (23 contro-lateral ligation) LPS	b) 80 no surgery	a) 31.5±4.2	n.s	a) ECP	n.s	a) TF 54 MF 7 END 5	n.s
Grynnerup et al 2013	P-CS	71	a) 16 (uni/bilateral) LPS	b,c) 55 no surgery	a) 34 (25-37) b) 33 (26-37) c) 32 (27-36)	n.s	a) HY	n.s	a) HY 16 b) TF 42 c) Unexplained 13	4-5 years
Uyar et al 2013	P	162	a) 33 patients LPS/LPT - 26 salpingectomy - 3 salpingostomy - 1 tubal milkink - 1 fimbriectomy - 2 tubal abortion	b) 49 MTX c) 80 no surgery	a) 31.1±5.1 b) 29.7 ± 5.0 c) 28.9 ± 6.0	n.s	a, b) ECP	n.s	n.s	n.s

19 manuscript focused on this topic

Ni et al 2013	PC	134	b) 34 unilateral c) 23 oviducts interruption by hemolock clip LPS	d) 51 no surgery	a) 29.23±2.98 b) 30.12±3.73 c) 30.65 ± 3.32 d) 29.18±3.36	a) 21.21±2.05 b) 21.37±1.89 c) 20.78±2.04 d) 20.95±1.66	a, b) ECP, HY c) HY	n.s	TF n.s	a) 2.00 ±1.67 b) 3.14 ±2.12 c) 4.61 ±2.81 d) 3.98 ± 2.44
Hill et al 2014	R	189	a) 36 unilateral not specified	b) 153 MTX	a) 35.8 ± 4.3 b) 34.3 ± 4.5	n.s	a, b) ECP	n.s	n.s	n.s
Ye et al 2015	R	198	a) 83 unilateral b) 41 bilateral not specified	c) 74 no surgery	a) 33,02 ±4,66 b) 33,58 ±3,95 c)33,8 ± 4,67	a) 21,63 ± 2,46 b) 21,1 ± 2,85 c) 21,43 ± 2,83	a) ECP 79 HY 2 TOA 1 b) ECP 24 HY 16 TOA 1	n.s	a) MF 45 b) MF 16 MF & FF 15 c) MF 38 MF & FF 26	a) 0.31 ±1.13 primary infertility b) 0.82 ± 1.96 primary infertility 3.23 ±3.24 secondary infertility; c) 3.6 ±4.15 primary infertility 2.36 ± 3.32 secondary infertility
Venturella et al 2015	RCT	186	a) 91 unilateral standard b) 95 unilateral wide* LPS	Controls: same patients before surgery	a) 41.16 ± 5.33 b) 41.56 ± 5.45	n.s	a, b) Myomectomy, tubal surgical sterilization	n.a	n.a	n.a
Lin et al 2013	R	288 cycles in 251 women	a) 103 cycles in 96 LPS salpingectomy	b) 185 cycles in 155 women no surgery	a) 33.2 ± 4.2 b) 32.8 ±4.6	a) 22.1 ±4.3 b) 21.9 ±3.2	a) ECP or HY	n.a	a,b) TF	n.a
Almog et al 2011	R	36	a) 36 (22 unilateral, 14 bilateral) LPS	Control: same patients before surgery	a) 34.2 ± 4.5	n.s	a) ECP 21 HY 14 Both 1	283 ±80 days	n.s	n.s
Bredkjaer et al 1999	RCC	278	a) 139 (128 bilateral, 11partial salpingectomy)	b) 139 no surgery	a) 32.6 (22-39) b) 32.9 (24-40)	n.s	a) HY	1.5-5 before IVF	a,b) TF	n.s
Dar et al 2000	R	26	a) 26 (25 unilateral, 1 bilateral) LPS	Control: same patients before surgery	a) 31.7 ± 3.6	n.s	a) ECP	< 3 years	a) MEF 16 MF 6 A 1 END 1 UN 2	n.s
Strandell et al 2001	RCT	26	a) 26 (9 unilateral and 17 bilateral LPS	Control same patients before surgery	a) 32.7 ± 3.6	n.s	a) HY	n.s	n.s	n.s

- 2269 Patients (1248 salpingectomy, 1021 Controls)
- Age < 40 years
- BMI < 25
- Indication for surgery : ECP or HY

Results

Effect of salpingectomy on AMH

AMH

- 4 article
- 589 patients
- 386 salpingectomy
- 389 controls

Authors & Years	Type of Study	Patients (total)	Patients (Salpingectomy)	Patients-Controls (No surgery)	Age (year ± SD)	BMI (± SD)	Indication for Surgery	Years from Surgery	Reason of Infertility	Duration of Infertility (year ± SD)
Grynnerup et al 2013	P-CS	71	a) 16 (uni/bilateral) LPS	b,c) 55 no surgery	a) 34 (25-37) b) 33 (26-37) c) 32 (27-36)	n.s	a) HY	n.s	a) HY 16 b) TF 42 c) Unexplained 13	4-5 years
Ni et al 2013	PC	134	a) 26 bilateral b) 34 unilateral c) 23 oviducts interruption by hemolock clip LPS	d) 51 no surgery	a) 29.23±2.98 b) 30.12±3.73 c) 30.65 ± 3.32 d) 29.18±3.36	a) 21.21±2.05 b) 21.37±1.89 c) 20.78±2.04 d) 20.95±1.66	a, b) ECP, HY c) HY	n.s	TF n.s	a) 2.00 ±1.67 b) 3.14 ±2.12 c) 4.61 ±2.81 d) 3.98 ± 2.44
Ye et al 2015	R	198	a) 83 unilateral b) 41 bilateral not specified	c) 74 no surgery	a) 33,02 ± 4,66 b) 33,58 ±-3,95 c)33,8 ± 4,67	a) 21,63 ± 2,46 b) 21,1 ± 2,85 c) 21,43 ± 2,83	a) ECP 79 HY 3 TOA 1 b) ECP 24 HY 16 TOA 1	n.s	a) MF 45 MF & FF 28 b) MF 16 MF & FF 15 c) MF 38 MF & FF 26	a) 0.31 ±1.13 primary infertility 2.85 ± 2.81 secondary infertility b) 0.82 ± 1.96 primary infertility 3.23 ±3.24 secondary infertility; c) 3.6 ±4.15 primary infertility 2.36 ± 3.32 secondary infertility
Venturella et al 2015	RCT	186	a) 91 unilateral standard b) 95 unilateral wide* LPS	Controls: same patients before surgery	a) 41.16 ± 5.33 b) 41.56 ± 5.45	n.s	a, b) Myomectomy, tubal surgical sterilization	n.a	n.a	n.a

Results

Ye et al 2015

- **AMH significantly higher in women without tubal surgery**
- **This data suggest that salpingectomy is associated with decreased ovarian reserve**


A retrospective analysis of the effect of salpingectomy on serum antiMüllerian hormone level and ovarian reserve

Xueping Ye, BS; Yue-shan Yang, MS; Xiao-zi Sun, MD

TABLE 1
Patient characteristics

Characteristic	Unilateral salpingectomy (n = 83)	Bilateral salpingectomy (n = 41)	Without surgery (n = 74)	*P* value
Age, y	33.02 ± 4.66	33.58 ± 3.95	33.8 ± 4.67	.553
AMH, (fmol/mL)	67.56 ± 127.03	127.11 ± 93.23	183.48 ± 104.3	.037
E2, pg/mL	38.3 ± 14.91	41.41 ± 16.59	36.49 ± 16.77	.291
Progesterone, nmol/L	0.52 ± 0.29	0.55 ± 0.33	0.54 ± 0.32	.848
LH, mIU/mL	4.06 ± 1.56	3.94 ± 1.75	4.26 ± 2.09	.63
FSH,	8.42 ± 2.3	9.13 ± 3.2	7.85 ± 2.69†	.048
AFC,	10.7 ± 3.62	9.58 ± 3.73	11.22 ± 4.16	.097

Grynnerup et al 2013

- **AMH levels were significantly lower in the salpingectomy infertility group compared with no salpingectomy tubal factor infertility group**
- **AMH predict poor response (5 o < oocytes) at 19 pmol/L cut off value**

Anti-Müllerian hormone levels in salpingectomized compared with nonsalpingectomized women with tubal factor infertility and women with unexplained infertility

ANNA G.-A. GRYNNERUP[1], ANETTE LINDHARD[1] & STEEN SØRENSEN[2]

[1]Fertility Unit, Copenhagen University Hospital Hvidovre, Hvidovre, and [2]Department of Clinical Biochemistry, Copenhagen University Hospital Hvidovre, Copenhagen, Denmark

Table 1. Demographics, baseline biochemistry and in vitro fertilization parameters.

Diagnosis group	Tubal factor, salpingectomy (*n* = 16)	Tubal factor, no salpingectomy (*n* = 42)	Unexplained infertility (*n* = 13)	All infertile groups (*n* = 71)	Fertile group (*n* = 21)	*p*-values[a]
Age (years)	34 (25–37)	33 (26–37)	32 (27–36)	33 (25–37)	32 (25–38)	NS
AMH in serum (LH + 7 days) (pmol/L)	16.1 (5.2–54)	23.4 (3.5–50)	21.8 (12–64)	21.9 (3.5–64)	17.2 (4.0–126)	Salpingectomy vs. tubal factor, no salpingectomy $p = 0.04$
Duration of infertility (years)	5 (3–10)	4 (1–12)	5 (2–7)	4 (1–12)	–	NS
No. of embryos transferred	2 (1–3)	2 (1–2)	2 (1–2)	2 (1–3)	–	NS
No. of oocytes retrieved	7 (3–31)	12 (3–30)	9 (9–38)	10 (3–38)	–	Salpingectomy vs. tubal factor with preserved tubes $p = 0.02$

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Results

Effect of salpingectomy on AFC

AFC

- 6 articles
- 727 patients
- 450 salpingectomy
- 487 controls

Authors & Years	Type of Study	Patients (total)	Patients (Salpingectomy)	Patients-Controls (No surgery)	Age (year ± SD)	BMI (± SD)	Indication for Surgery	Years from Surgery	Reason of Infertility	Duration of Infertility (year ± SD)
Chan et al 2003	R	32	a) 18 unilateral LPS b) 14 unilateral LPT	Controls: non-operated site	a) 34 (31-38) b) 36 (33-44)	a) 20.96 b) 21.44	a, b) ECP	At least 3 months	n.s	n.s
Orvieto et al 2011	R	15	a) 15 uni/bilateral not specified	Controls: same patients before surgery	32 ± 4.4	24 ± 5.5	a) HY	n.s	n.s	n.s
Uyar et al 2013	P	162	a) 33 patients LPS/LPT - 26 salpingectomy - 3 salpingostomy - 1 tubal milkink - 1 fimbriectomy - 2 tubal abortion	b) 49 MTX c) 80 no surgery	a) 31.1±5.1 b) 29.7 ± 5.0 c) 28.9 ± 6.0	n.s	a, b) ECP	n.s	n.s	n.s
Ni et al 2013	PC	134	a) 26 bilateral b) 34 unilateral c) 23 oviducts interruption by hemolock clip LPS	d) 51 no surgery	a) 29.23±2.98 b) 30.12±3.73 c) 30.65 ± 3.32 d) 29.18±3.36	a) 21.21±2.05 b) 21.37±1.89 c) 20.78±2.04 d) 20.95±1.66	a, b) ECP, HY c) HY	n.s	TF n.s	a) 2.00 ±1.67 b) 3.14 ±2.12 c) 4.61 ±2.81 d) 3.98 ± 2.44
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Results

Orvieto et al 2011

Chan et al 2003

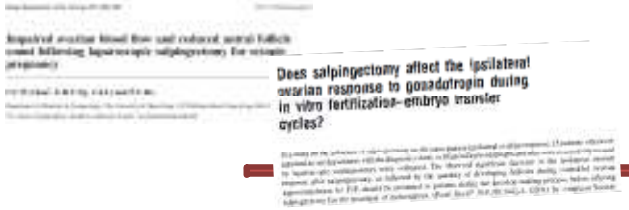
Reduced ovarian response of the ipsilateral ovary after unilateral salpingectomy

TABLE 1

Comparison between IVF cycles before and after salpingectomy.

	Before salpingectomy	After salpingectomy	*P* value
Length of stimulation, d	10.8 ± 1.5	10.5 ± 1.7	NS
No. of gonadotropin ampoules used	49.8 ± 22.7	48.2 ± 26.3	NS
Peak E_2 levels on day of hCG administration, pg/mL	1,996 ± 885	2,020 ± 981	NS
P levels on day of hCG administration, ng/mL	0.8 ± 0.5	1.2 ± 1.9	NS
No. of follicles on the affected side	5.6 ± 2.5	4.7 ± 2.3	*P*<.02
No. of follicles on both sides	11.4 ± 4.5	9.5 ± 4.9	*P*<.005
No. of follicles ≥ 15 mm on the affected side	5.0 ± 2.3	4.5 ± 2.3	*P*=.18
No. of follicles ≥ 15 mm on both sides	9.8 ± 3.9	8.5 ± 4.4	*P*<.006
No. of oocytes retrieved	11.6 ± 5.9	10.2 ± 6.1	*P*=.06
No. of embryos transferred	2.7 ± 1.1	2.3 ± 0.7	NS
CPR (%)	1/15 (6.7), +1 ectopic pregnancy	6/15 (40), +1 biochemical pregnancy	*P*<.019

Orvieto. IVF cycle after salpingectomy. Fertil Steril 2011.



Does salpingectomy affect the ipsilateral ovarian response to gonadotropin during in vitro fertilization–embryo transfer cycles?

Table I. Ovarian function between the operated and the non-operated side in the laparotomy group (n = 14)

	Operated side	Non-operated side	P^a
Antral follicle count	6.5 (1.8–10.3)	4.0 (2.8–9.3)	0.165
Ovarian volume (cm³)	7.73 (5.09–11.04)	6.76 (4.01–8.74)	0.683
VI (%)	0.84 (0.11–1.42)	0.73 (0.24–1.29)	0.683
FI (0–100)	26.58 (23.74–28.37)	24.37 (22.77–26.70)	0.397
VFI (0–100)	0.23 (0.03–0.39)	0.18 (0.06–0.32)	0.510

Values are median (interquartile range).
[a]Wilcoxon signed ranks test.
VI = vascular index; FI = flow index; VFI = vascularization flow index.

Table II. Ovarian function between the operated and the non-operated side in the laparoscopy group (n = 18)

	Operated side	Non-operated side	P^a
Antral follicle count	5. 0 (3.0–7.3)	7.5 (4.8–8.3)	0.014
Ovarian volume (cm³)	6.33 (4.07–6.90)	5.93 (4.57–8.24)	0.349
VI (%)	0.55 (0.22–0.87)	1.03 (0.39–2.53)	0.020
FI (0–100)	24.97 (22.09–26.95)	27.79 (24.71–33.78)	0.020
VFI (0–100)	0.14 (0.05–0.23)	0.37 (0.10–0.84)	0.020

Values are median (interquartile range).
[a]Wilcoxon signed ranks test.
VI = vascular index; FI = flow index; VFI = vascularization flow index.

Results

Effect of salpingectomy on IVF

IVF

16 manuscript focused on this topic

Eterogenity of the study:

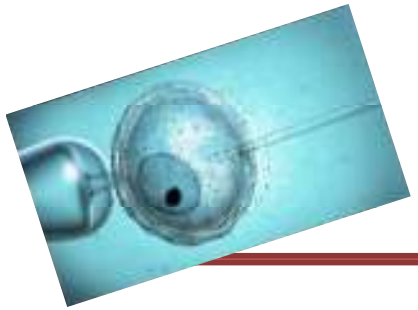
- Different protocol of stimulation
- Salpingectomy LPS or LPT or not specified
- Different indication for surgery

Patients who underwent salpingectomy retrieved significantly **fever oocytes**

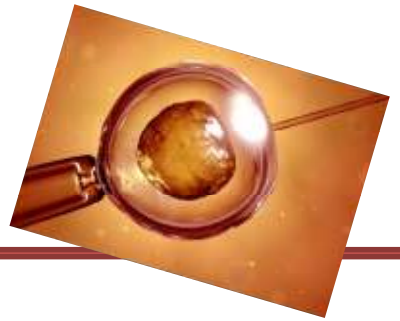
Required **higher dose of gonadotropine** to attain the same number of mature oocytes

Similar implantation rate, clinical pregnancy rate and LBR

Similar number of follicles retrieved ipsilateral to the operated side



Salpingectomy **improving IVF** outcome



Results

Effect of salpingectomy on IVF


International Journal of Gynecology and Obstetrics

CLINICAL ARTICLE

Ovarian response to gonadotropins after laparoscopic salpingectomy for ectopic pregnancy

Wenyan Xi [a], Fei Gong [a,b], Yi Tang [a,b], Hong Zhang [b], Guangxiu Lu [a,b,c]

- Retrospective
- Good numerosity: 76 salpingectomy vs 80 control
- Indication: ECP
- LPS salpingectomy had no detrimental effect on ovarian response during IVF-ET

Gynecol Endocrinol. 2013 Apr;29(4):345-9. doi: 10.3109/09513590.2012.743004. Epub 2013 Jan 22.

Influence of various tubal surgeries to serum antimullerian hormone level and outcome of the subsequent IVF-ET treatment.

Ni L[1], Sadiq S, Mao Y, Cui Y, Wang W, Liu J.

- Prospective cohort
- Unilateral, bilateral salpingectomy
- Indication: HY, ECP
- Salpingectomy improved IVF outcome especially for hydrosalpinx


RESEARCH

GYNECOLOGY

A retrospective analysis of the effect of salpingectomy on serum antiMüllerian hormone level and ovarian reserve

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- Retrospective
- Good numerosity: 124 salpingectomy (unilateral–bilateral)
- Indication: ECP, HY
- Patients treated with salpingectomy retrieved fever oocytes, poorer IVF outcomes

Conclusion

Experienced surgeon

Salpingectomy seems to be associated with decreased AMH level (thermal damage), but few studies found no significant differences of AMH level before and after surgery

Define technique

Also AFC seems to be reduced after salpingectomy → need further study

IVF outcome after salpingectomy is more controversial:

- **No effect on IVF**
- **Improved IVF outcome especially for hydrosalpinx**
- **Undermines OR and reduced oocyte retrieved (interrupted ovarian blood supply)**

Define the grade of hydrosalpinx that require surgery

Grazie per l'attenzione