

# Vasectomy reversal semen analysis: new reference ranges predict pregnancy

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**Objective:** To study the semen analysis values required to cause a pregnancy after vasectomy reversal (VR). Vasectomy reversal is increasingly performed on men who wish to regain fertility after elective sterilization. Despite a thorough understanding of predictors of vasal patency after surgery, little is known about the patients' semen parameters and pregnancy potential.

**Design:** Retrospective case-control study.

**Setting:** Tertiary-care hospital.

**Patient(s):** A total of 139 patients who underwent VR at the Cleveland Clinic from 2010 to 2014.

**Intervention(s):** Vasectomy reversal.

**Main Outcome Measure(s):** Pregnancy, semen parameters. Data regarding patient and spouse ages, obstructive interval, intraoperative findings, procedure performed, postoperative semen results, and spontaneous pregnancy outcome were collected. Pearson and *t* tests were used to analyze categoric and numeric data, respectively. Average semen reference values were developed.

**Result(s):** The mean obstructive interval was  $9.5 \pm 1.2$  years. Spontaneous pregnancy was achieved by 49.6% of patients (69/139) and was directly related to better intraoperative vasal fluid quality and postoperative sperm concentration, motility, and strict morphology. The reference ranges of postoperative semen parameters of patients with spontaneous pregnancy were substantially lower than normal values published by the World Health Organization (WHO) in 2010. Spontaneous pregnancy was reported in 15%, 21.3%, and 14.8% of patients with a sperm concentration of  $<5$  million/mL, a sperm motility of  $<10\%$ , and a normal morphology of  $<1\%$ , respectively.

**Conclusion(s):** Normal ranges of semen parameters as established by the 2010 WHO standards may not adequately predict post-vasectomy reversal fertility. Significantly lower post-reversal semen parameters may be considered to be sufficient in previously fertile patients after reversal compared with the normal population. (Fertil Steril® 2017; ■:■-■. ©2017 by American Society for Reproductive Medicine.)

**Key Words:** Vasectomy, vasectomy reversal, semen analysis, pregnancy rate

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Vasectomy is a safe and effective method of contraception used by ~ 42–60 million couples worldwide (1). Up to 6% of men undergoing this contraceptive procedure ultimately request a reversal for a variety of reasons, including a new partner or loss of a child (2, 3). Since the first vasovasostomy (VV) was reported in 1948 and the introduction of

microsurgery in the late 1970s (4, 5), vasectomy reversal (VR) has become a common treatment for men who desire additional children after undergoing vasectomy.

Several studies have looked into the factors influencing vasal patency after VR. Factors such as obstructive interval (OI), vasal fluid characters at time of reversal, and type of surgical

procedure performed were most influential (6–8). Although most studies evaluated postoperative patency characterized by the return of sperm to the ejaculate, fewer studies addressed postoperative pregnancy outcomes. Considerable debate exists on the value of conventional semen analysis as a predictor of pregnancy in the general population, and certainly such debate is just as appropriate in the post-VR patient population. Semen parameter reference values associated with successful pregnancy in men after VR have never been described. This is the first study designed to explore this aspect in search for an answer.

Received December 9, 2016; revised January 6, 2017; accepted January 24, 2017.

A.M. has nothing to disclose. N.N.T. has nothing to disclose. A.S.P. has nothing to disclose. R.S. has nothing to disclose. A.A. has nothing to disclose. E.S. has nothing to disclose.

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Fertility and Sterility® Vol. ■, No. ■, ■ 2017 0015-0282/\$36.00

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<http://dx.doi.org/10.1016/j.fertnstert.2017.01.018>

## MATERIALS AND METHODS

In this retrospective study, records of 171 consecutive patients who underwent VR at the Glickman Urological and Kidney Institute at the Cleveland Clinic from January 2010 to December 2014 were reviewed. 139 patients had complete records with pregnancy data. The study design was approved by the institute's Institutional Review Board and a waiver of signed informed consent was used. Patients who had a known postoperative spontaneous pregnancy outcome (as defined by a positive hCG urine or blood test) were included in the study. Patients in whom the pregnancy outcome was unknown or who used assisted reproduction for pregnancy were excluded. Data regarding patient and spouse ages, OI, intraoperative findings, procedure performed, postoperative semen results, and spontaneous pregnancy outcome were collected. Patients were divided into two groups according to spontaneous pregnancy outcome. Group I patients were successful in achieving spontaneous pregnancy within 18 months of VR, and group II did not have a successful pregnancy within that same time frame.

### Surgical Procedure

Vasal reconstructive surgery was performed on all patients with the use of a magnifying surgical microscope (Leica Microsystems). We performed a formal two-layer ( $n = 65$ ) or modified one-layer ( $n = 74$ ) vasal reconstruction as previously described in the literature (6, 9). Cases where no sperm or sperm parts were seen in the vasal effluent fluid underwent vasoepididymostomy (VE). A standard end-to-side anastomosis was performed between a sperm-containing epididymal tubule and the distal vas (10).

Six weeks after the surgical procedure, a semen analysis was performed by all patients after 3–5 days of sexual abstinence. Collection was done through masturbation into a clean container, and samples were incubated at 37°C and allowed to liquefy for 30 minutes before analysis. The analysis was performed according to World Health Organization (WHO) guidelines adopted in 2010 (11). Only the initial 6-week post-reversal semen analysis was included in this study.

All collected variables were compared between the study groups. The total motile sperm concentration (TMC; calculated by multiplying semen volume  $\times$  concentration  $\times$  total motility) was measured. Patients were subclassified according to different semen parameter levels; semen volume ( $<1.5$  mL,  $>1.5$  mL); sperm concentration ( $<5$  million/mL, 5–15 million/mL,  $>15$  million/mL); total motility ( $<10\%$ , 10%–40%,  $>40\%$ ); TMC ( $<5$  million, 5–20 million,  $>20$  million); and normal strict morphology (1%–4%,  $>4\%$ ).

### Statistical Analysis

Categoric variables were expressed as  $n$  (%), and numeric variables were presented as mean  $\pm$  SEM. Pearson chi-square test ( $\times 2$ ) and Mann-Whitney  $U$  test were used for categoric variables and numeric variables, respectively. Descriptive statistics were used to determine the percentile ranks of semen parameters associated with spontaneous pregnancy. A  $P$  value of  $<.05$  was considered to be significant. All data was analyzed with the use of SPSS version 20.1 (IBM).

## RESULTS

The overall patency rate (as defined by the presence of any sperm in the ejaculate) was 91.8%. In 139 patients, the spontaneous pregnancy outcome was available. Sixty-nine (49.6%) of those patients successfully achieved spontaneous pregnancy within a mean duration of  $1.3 \pm 0.08$  years (group I). Characteristics and comparisons between the two study groups are presented in Table 1. Patient and partner ages did not significantly differ between the two groups ( $P = .33$  and  $P = .61$ , respectively). Vasectomy mean OI was  $9.35 \pm 0.6$  years for group I patients and  $10.42 \pm 0.68$  years for group II patients ( $P = .24$ ). Of the patients for whom pregnancy data were available, 108 patients underwent bilateral VV, nine patients unilateral VV/unilateral VE, 14 patients bilateral VE, two patients unilateral VV, and six patients unilateral VE (Table 1). The type of surgical reconstruction performed significantly affected spontaneous pregnancy outcome, with the highest probability achieved when bilateral VV was performed (92.8%;  $P = .001$ ). Four patients had undergone earlier VV reconstruction, and all of them were unsuccessful in achieving spontaneous conception after surgery. The presence of sperm or sperm parts was the only intraoperative variable found to significantly influence spontaneous pregnancy rate. Sperm or sperm parts were identified in 95.6% and 65.7% of group I and group II patients, respectively ( $P = .001$ ). Sperm concentration ( $P = .017$ ), total motility ( $P = .001$ ), total motile concentration ( $P = .001$ ), and normal morphology ( $P = .001$ ) were significantly higher among group I patients compared with group II patients (Table 1).

The reference values of postoperative semen parameters from men who successfully achieved spontaneous pregnancy are presented in Table 2.

For a conventional two-sided distribution, the 5th-percentile lower reference limits observed for sperm

**TABLE 1**

#### Factors affecting spontaneous pregnancy after vasectomy reversal.

Factor	Spontaneous pregnancy		P value
	Yes (n = 69)	No (n = 70)	
Patient age (y)	32.1 $\pm$ 0.75	33.1 $\pm$ 0.69	.33
Partner age (y)	31.16 $\pm$ 0.51	31.5 $\pm$ 0.55	.61
Surgery type			
Bilateral VV	64 (92.8)	44 (62.9)	.001
VV/VE	4 (5.8)	5 (7.1)	
Bilateral VE	0 (0)	14 (20)	
Unilateral VV	0 (0)	2 (2.9)	
Unilateral VE	1 (1.4)	5 (7.1)	
VV type			
Formal two-layer	31 (44.9)	34 (48.6)	.81
Modified one-layer	38 (55.1)	36 (51.4)	
Intraoperative vasal fluid quality			
Clear	48 (69.6)	36 (51.5)	.95
Cloudy	15 (21.7)	18 (25.7)	
Pasty	6 (8.7)	14 (20)	
None	0 (0)	2 (2.8)	
Intraoperative sperm quality			
Sperm/sperm parts	65 (95.6)	46 (65.7)	.001
No sperm	3 (4.4)	24 (34.3)	

Note: Results are presented as mean  $\pm$  SEM or  $n$  (%). VE = vasoepididymostomy; VV = vasovasostomy.

Majzoub. Vasectomy reversal semen reference range. *Fertil Steril* 2017.

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