

## Pregnancy rates after vasectomy: a survey of US urologists

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### Abstract

We surveyed 2000 US urologists using mailed questionnaires. The aim of this survey was to estimate the incidence of pregnancy after vasectomy and to gather information on the surgical methods used. Of 586 responding urologists, 538 reported performing vasectomies, and they reported a total of 177 pregnancies during the preceding 5 years. Ninety pregnancies (51%) were attributed to unprotected intercourse during the immediate post-vasectomy period. The remaining pregnancies were attributed to recanalization or other less common causes of method failure. Based on the number of vasectomies performed by these surgeons, about 1 pregnancy was reported per 1000 vasectomies. This is probably an underestimate of the true rate. The risk of pregnancy was lower following vasectomies by surgeons who performed more than 50 procedures per year. © 2004 Elsevier Inc. All rights reserved.

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### 1. Introduction

Vasectomy is a simple and effective method of permanent male contraception, used by approximately 40 million couples worldwide [1]. However, although vasectomy offers several advantages over female sterilization [2], it remains far less known and used, even in the countries, including the United States [1,3], where it constitutes a significant family-planning method. In 1995, 11% of American women of reproductive age reported relying on vasectomy for contraception; this prevalence has remained stable since the late 1970s and is markedly less than the 28% of women who reported having tubal ligation [3,4]. Improving the knowledge of vasectomy among potential contraceptive users and family-planning services providers could add to women's contraceptive options, and help reduce the number of unintended pregnancies worldwide.

A review of the available literature on vasectomy shows unresolved issues about this method [5]. The incidence of vasectomy failure among men who have undergone surgical sterilization remains uncertain and perhaps underestimated. The available estimates of pregnancy rates after vasectomy are mostly based on retrospective reviews of case series

from single institutions, and often lack details on the length of follow-up [5,6]. Furthermore, the effectiveness of avoiding unprotected sex during the first weeks after vasectomy, a sensitive period during which pregnancy might occur, has received little attention.

In the United States, data on vasectomy practice and failures are not collected routinely. We, therefore, surveyed a national sample of US urologists to document vasectomy practices and provide estimates of post-vasectomy pregnancy rates.

### 2. Materials and methods

We mailed surveys to a random sample of 2000 practicing US urologists in July 1998. The sample was randomly selected from the American Medical Association (AMA) master file listing of all urologists. We stratified the sampling into four census regions, and used a sampling probability proportional to the estimated numbers of vasectomies performed by urologists in each region [7]. The target sample allocation by region was: North East, 20%; North Central, 25%; South, 35% and West, 20%. The use of this standard sample probability allows the sample to be considered nationally representative of vasectomy procedures performed by urologists in the United States.

We sent the same questionnaire in two successive mailings approximately 1 month apart. Each mailing included a

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cover letter assuring respondents that their responses would be anonymous, and the response format was designed to assure anonymity. We continued to receive responses for about 2 months following the second mailing. All responses, even those received late, were included in the analysis. We made a few telephone calls to physicians' offices to confirm that the survey instrument was received and was easy to fill out, but we did not have the resources to systematically call physicians' offices. No incentives were offered for completing the questionnaire.

We asked about vasectomy experience, years of vasectomy practice, numbers of procedures done during the previous 12 months, surgical methods used, follow-up rate and numbers of reported pregnancies after vasectomies in the last 5 years, asking the respondents to differentiate pregnancies due to user failure and those attributed to technique failure. A separate page contained data on the sampled urologist's region and decade of birth, obtained from the AMA master file. The respondents were given the option of not returning this last page. The questionnaire was separated from the page containing demographic information immediately after it was received, so that any identifying data was unlinked immediately from the questionnaires upon receipt.

We summarized characteristics of vasectomy practice with descriptive statistics: minimum, maximum, median, mean and standard deviation values for quantitative variables and distribution by category for qualitative variables. In order to examine associations between variables, we categorized some quantitative variables as follows:  $\leq 20$  vs.  $> 20$  for the number of years of vasectomy practice,  $\leq 50$  vs.  $> 50$  for the number of vasectomies done during the last 12 months,  $\leq 90\%$  vs.  $> 90\%$  for the proportion of vasectomies followed by semen analysis. We tested associations between variables and pregnancy outcomes with  $\chi^2$  tests and logistic regression. Tests of associations were adjusted by region.

To estimate the incidence of pregnancy, we made the assumption that the annual number of vasectomies reported for the previous 12 months by all the respondents had been constant for the previous 5 years. The reported stability of vasectomy incidence nationally between 1991 and 1995 [7], along with the large number of participants, makes this assumption reasonable. Urologists who had performed vasectomies for less than 5 years ( $n = 27$ ) were excluded from this analysis. The cumulative incidence of post-vasectomy pregnancy was calculated as the ratio of the total number of reported pregnancies to the estimated 5-year total of vasectomies. Since timing of the events was not collected, this is considered an estimate of the incidence of pregnancy 2.5 years after vasectomy.

Poisson regression was used to examine factors associated with reported pregnancy after vasectomy, among the urologists who had performed vasectomies for at least 5 years. The number of reported pregnancies was entered in the model as the dependent variable, and independent variables included the number of years of vasectomy practice,

Table 1  
Characteristics of respondents

	Respondents	Total sample
	( $n = 500$ ) <sup>a</sup>	( $n = 2000$ )
	n (%)	n (%)
Census region		
North East	111 (22.2)	400 (20.0)
North Central	180 (36.0)	494 (24.7)
South	104 (20.8)	708 (35.4)
West	105 (21.0)	398 (19.9)
Decade of birth		
1910	2 (0.4)	26 (1.3)
1920	18 (3.6)	110 (5.5)
1930	97 (19.5)	424 (21.2)
1940	188 (37.7)	691 (34.5)
1950	135 (27.1)	546 (27.3)
1960	58 (11.7)	203 (10.2)

<sup>a</sup> 86 respondents did not return the page containing demographic information.

the number of vasectomies performed, the percentage of men returning for follow-up and the surgical method used, all expressed as categorical variables. Distinct models were used to examine the determinants of (a) all pregnancies, (b) pregnancies attributed to user failure and (c) pregnancies attributed to method failure. In the context of vasectomy procedures, a "user failure" is generally considered to be a pregnancy conceived during the 12-week waiting period immediately after vasectomy when couples are advised to use a backup method of contraception.

### 3. Results

Responses were obtained from 586 urologists, representing 29.3% of the target sample. Comparing respondents vs. nonrespondents, the distribution by census region was different ( $p < 0.001$  for  $\chi^2$  test), but the age distribution was similar (Table 1).

#### 3.1. Vasectomy practice

Five-hundred and thirty-eight of the 586 respondents (91.8%) reported having ever done vasectomies. The rest of this analysis is limited to these 538 vasectomy providers. These providers had medians of: 20 years of vasectomy practice; 50 vasectomies performed during the preceding 12 months and a 90% return rate of men for semen analysis (Table 2). Providers who began doing vasectomies more recently than 20 years ago reported having done more vasectomies during the last 12 months than the more senior practitioners ( $p = 0.02$  for Mantel-Haenszel  $\chi^2$  test). More men reportedly returned for semen analysis after procedures by surgeons who performed fewer procedures during the last 12 months ( $p < 0.01$  for Mantel-Haenszel  $\chi^2$  test).

Of the vasectomy methods used routinely in the last 5

Table 2  
Vasectomy experience among the 538 vasectomy providers

	Median	Min–max	Mean $\pm$ SD
Years of vasectomy practice <sup>a</sup>	20	1–43	18.9 $\pm$ 9.1
Vasectomies performed during the last 12 months <sup>b</sup>	50	0–500	66.2 $\pm$ 65.0
Percentage of men returning for semen analysis <sup>c</sup>	90	0–100	82.7 $\pm$ 20.4

Missing values: <sup>a</sup> = 1; <sup>b</sup> = 5; <sup>c</sup> = 13.

years, ligation plus cautery was the most commonly used procedure, by 39.2% of surgeons (Table 3). Overall, fascial interposition was used by 40% of surgeons in combination with various other techniques. Four-hundred providers (74% of the 538) checked only one of the listed vasectomy techniques. The distribution of vasectomies by surgical methods was examined among providers who used the same surgical procedure for all the vasectomies they performed (Table 3). Fascial interposition was used in 29% of these vasectomies. After adjustment by numbers of vasectomies performed and by region, urologists with 20 years or less of vasectomy practice were less likely to use one occlusion method alone (logistic regression,  $p = 0.004$ ) and more likely to use a combination of occlusion methods (logistic regression,  $p = 0.01$ ) (data not shown).

Fifteen surgeons, representing 2.8% of the sample, reported ever using vas irrigation.

### 3.2. Pregnancies after vasectomy

The 538 urologists reported a total of 177 pregnancies. Ninety (51%) were early pregnancies and were attributed to “non-compliance with the recommended waiting period or failure of a backup contraceptive. . . .” and were reported to have been conceived “within a few weeks” of the vasectomy procedure. Eighty-seven (49%) were attributed to vasectomy failure “due to recanalization, duplicate vas, etc.,” and could have been conceived at any time post-vasectomy.

Table 3  
Distribution of urologists and vasectomies by vasectomy method used in the last 5 years

Method	Urologists		Vasectomies <sup>a</sup>	
	<i>n</i>	% <sup>b</sup>	<i>n</i>	%
Ligation + cautery	211	39.2	5412	20.1
Ligation + fascial interposition	158	29.4	3982	14.8
Clips + cautery	104	19.3	5461	20.2
Cautery only	57	10.6	2461	9.1
Ligation only	47	8.7	3179	11.8
Clips only	39	7.2	1729	6.4
Cautery + fascial interposition	28	5.2	2607	9.7
Other <sup>c</sup>	51	9.5	2149	7.9
Total	NA	NA	26,980	100.0

<sup>a</sup> Among the 400 urologists who used only one method.

<sup>b</sup> Total > 100% because multiple answers possible.

<sup>c</sup> Combinations of the above techniques or other techniques, which had not been included on the questionnaire.

Among the 511 urologists who had been doing vasectomies for at least 5 years, the estimated incidence of pregnancy 2.5 years after vasectomy was 1/1000 procedures (95% confidence interval (CI): 0.85/1000; 1.15/1000). The estimate was 0.51/1000 procedures (95% CI: 0.40/1000; 0.62/1000) for early pregnancies attributed to nonadherence, and 0.49/1000 (95% CI: 0.38/1000; 0.60/1000) for pregnancies attributed to vasectomy failure.

The reported incidence of all pregnancies among the urologists who had performed more than 50 vasectomies during the previous 12 months was half that of urologists performing fewer procedures (Table 4). The reported incidence of pregnancies attributed to method failure tended to be higher among urologists who had been doing vasectomies for more than 20 years, but this result was of borderline significance. No significant association was found between the number of pregnancies reported and the surgical method used (Poisson regression results not shown).

## 4. Discussion

One limitation of this survey is the low response rate, which could have introduced a selection bias if the respondents differed from the nonrespondents in their vasectomy practice. However, the distribution by decade of birth was similar among the respondents and the total target sample. The distribution by region showed a higher proportion of respondents from the “North Central” region and a lower proportion of respondents from the “South” than the ones targeted in the total sample, so the tests of associations were adjusted by region. The proportion of surveyed urologists who reported having previous vasectomy experience was consistent with the report of 92% of US urologist practices performing the procedure in 1995 [7]. Furthermore, there was no evidence for selection of urologists with markedly greater experience of vasectomy, since the 586 participants represented approximately 7% of all US urologists, as per the AMA master file, and the total number of vasectomies they reported for the last 12 months amounted to about 9% of all vasectomies performed nationwide annually by urologists [7].

### 4.1. Vasectomy practice

A previous study described profiles of US vasectomy providers [7,8]. That study looked at three types of provid-

Table 4  
Factors associated with pregnancy after vasectomy, by Poisson regression<sup>a</sup>

Independent variables	Dependent variable					
	All reported pregnancies		Pregnancies attributed to nonadherence		Pregnancies attributed to technique failure	
	Estimate	p value*	Estimate	p value*	Estimate	p value*
No. of vasectomies <sup>b</sup>	-0.71 <sup>c</sup>	0.004	-0.92	0.01	-0.42	0.08
Years of vasectomy practice <sup>d</sup>	0.33	0.18	0.20	0.57	0.39	0.08
% Semen analysis <sup>e</sup>	0.08	0.63	0.35	0.32	/	/
Missing	23		15		25	

<sup>a</sup> The natural-logarithm transformed value of the number of vasectomies was used in the model fitting.

<sup>b</sup> 2 categories:  $\leq 50$  (ref cat.),  $> 50$  vasectomies during last 12 months.

<sup>c</sup> This corresponds to a relative risk of 0.49 for urologists doing  $> 50$  vasectomies per year.

<sup>d</sup> 2 categories:  $\leq 20$  (ref cat.),  $> 20$  years of vasectomy practice.

<sup>e</sup> 2 categories:  $\leq 90\%$  (ref cat.),  $> 90\%$  of vasectomies followed by semen analysis.

\* p for comparison of parameter to 0 (z test).

ers: urologists, family practitioners and general surgeons, and reported information on numbers of vasectomies, surgical techniques and protocols for ensuring azoospermia. The study did not gather information on: the use of vas irrigation, men's adherence with semen testing protocols or on pregnancies after vasectomy. Our survey is the first to provide information on pregnancies after vasectomy from a population-based sample of US urologists.

The reported proportion of men returning for semen analysis may have been overestimated, as completion of this survey instrument did not require a chart review. Ideally, all men should have at least one semen analysis after vasectomy and many experts recommend two semen analyses [9]. Most reports of vasectomy series based on chart reviews report a proportion of about 70% of vasectomies followed by semen analysis in the United States [5]. We interpreted the negative association between the number of vasectomies performed and the percentage of men returning after the procedure as an overestimation of follow-up among the providers with low vasectomy experience.

Vasectomy providers whose practice was more recent were found to be doing more vasectomies. This association may reflect a cohort effect. Assuming that the number of years of vasectomy practice is a proxy measure for the number of years since medical training, urologists from different age cohorts may have different attitudes toward vasectomy and/or have acquired different skills during their early training. This finding suggests that changes in the content of medical students and residents' training could be an important approach to influencing national trends in qualitative and quantitative aspects of vasectomy practice.

#### 4.2. Surgical methods

This sample of US urologists reported a great diversity of vasectomy methods. This heterogeneity in practice reflects the absence of rigorously demonstrated superiority of one

method over others. Although no well-controlled comparison of failure rates with various vasectomy occlusion methods has been published, results from observational studies have nevertheless suggested differences in effectiveness, generally based on the results of semen analysis [1,9]. More rigorous trials, preferably randomized controlled trials, are needed to validate current opinions on the effectiveness of various occlusion techniques and guide providers' practice [10]. Family Health International and EngenderHealth recently completed a multicenter trial to evaluate the value of fascial interposition when used with suture ligation. Results from an interim analysis showed the superiority of fascial interposition plus ligation and excision over the use of ligation and excision alone, and led to early termination of recruitment [11]. Results of the final analysis have been submitted for publication.

The results of our survey suggest that, in the United States, 18% of vasectomies are performed with ligation alone or clips alone (Table 3), and could presumably be classified in the lowest category of effectiveness. However, we did not obtain information on the number of clips used on each vas, which is an important aspect of clip use [9].

The observed preferential use of protocols combining several occlusion methods among the "younger" vasectomy providers may indicate a temporal trend toward the use of potentially more effective methods. It may also reflect the importance of liability issues in medical practice. Providers may feel more protected against lawsuits if they combine several methods.

Vas irrigation with water, saline or other agents has been suggested as a method for avoiding conceptions immediately after vasectomy, but only 15 (2.8%) of the surgeons in our sample reported ever using vas irrigation. Research suggests that vas irrigation with saline or sterile water does not decrease the time to azoospermia [12–14], and there is no US Food and Drug Administration (FDA)-approved drug for this indication.

### 4.3. Pregnancies

To our knowledge, our data constitute the largest published series of pregnancies after vasectomy. The estimates of reported pregnancy rates obtained in this study could be considered nationally representative of vasectomy practice by US urologists. However, basing pregnancy assessment on urologists' reports introduces several limitations. Underreporting of pregnancies from women to men is likely. Women whose husbands or partners have undergone a vasectomy and who get pregnant may hide their pregnancy and seek an abortion due to fear of being accused of infidelity, with potentially serious personal and social consequences. Underreporting from men to urologists is also probable, particularly for late pregnancies. Finally, urologists may have forgotten events or the exact dates of events that occurred several years in the past. This last factor could have led to over- or underestimation. Overall, these limitations make underestimation likely and the present results should be regarded as minimal estimates of pregnancy rates after vasectomy.

Given the probability of underestimation due to study design, the 1/1000 pregnancy incidence that we found in this study suggests that the failure rate after vasectomy in the United States could be higher than commonly thought. Trussell's often cited 1-year estimates (1 pregnancy for perfect use and 1.5 pregnancy for typical use for every 1000 vasectomies) [15], are slightly higher than our estimate of 1/1000 for typical use within the first 2.5 years after vasectomy. However, Trussell's estimates might still underestimate the true number since his estimates are based on published data that may be subject to publication bias. Other US data on pregnancy after vasectomy are available from the CREST cohort comparison group. Those data provide an estimate of the pregnancy rate among the 544 wives of men who had undergone vasectomies in university teaching hospitals [15]. Six pregnancies were reported after 5 years, four in the first year and two in the second year. Three of the six pregnancies were judged to be user failures. Including all six pregnancies gives cumulative pregnancy rate estimates of 9.2/1000 procedures at 1 year and 18.5/1000 procedures for years 2–5, similar to the estimates after female sterilization [15,16]. Although these estimates are based on a small number of events, they suggest that pregnancy after vasectomy may occur more frequently than previously considered. On the other hand, procedures done in teaching hospitals may often be done by less experienced surgeons.

To our knowledge, this is the first study that provides a population-based estimate of the US incidence of both method and user failures. We found one pregnancy due to user failure for every 2000 procedures, in conditions where high adherence is expected, because vasectomies are mainly performed on high-income educated men in the United States [17,18]. This is lower than found in a recently reported study by Nazerali et al. [19]. That study, conducted in rural Nepal, identified seven pregnancies among 924 men

(7.6/1000) that were attributed to user failure during the first 3 months after vasectomy. For vasectomy programs in low-resource settings where nonadherence is more likely, finding methods to better manage this early period is desirable. An effective, FDA-approved method of vas irrigation or more effective occlusion methods might help reduce such pregnancies.

Another limitation to this estimate is that in the United States, vasectomy acceptors are generally older than vasectomy acceptors in other countries, especially developing countries. Data from China [20,21] and from Nepal suggest a strong influence of age on pregnancies following vasectomy procedures. The Nepal study found a higher rate of pregnancies in wives of younger men, and no pregnancies were reported for wives who were over 32 years of age.

Providers who performed more vasectomies reported lower pregnancy rates. Urologists with greater vasectomy experience may provide better counseling for the first weeks, and experience fewer surgical failures. This finding is consistent with previous reports describing higher failure rates after vasectomies performed by less experienced surgeons [1,22].

## 5. Conclusions

This survey of US urologists provides a population-based estimate of the pregnancy rate after vasectomy in the United States. This study's crude estimate of one pregnancy per 1000 in the first 2.5 years after vasectomy is close to Trussell's estimate [6], but is probably an underestimate of the actual rate. The estimated risk of post-vasectomy pregnancy was reduced by half after procedures by surgeons who performed more than 50 vasectomies per year.

The incidence of pregnancies due to presumed recanalizations could be reduced by the preferential use of the most effective surgical methods, if their greater effectiveness were well established. Controlled trials are needed to evaluate the effectiveness of common vas occlusion techniques.

Half of the pregnancies reported in this study were attributed to user failure. This emphasizes the importance of counseling and the potential usefulness of innovative approaches to reduce the risk of early pregnancy following vasectomy.

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