

PATIENT CHARACTERISTICS ASSOCIATED WITH VASECTOMY REVERSAL

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ABSTRACT

Purpose: More than 30 million couples throughout the world are using vasectomy as a method of birth control. It is estimated that up to 6% of men who undergo voluntary sterilization will eventually request reversal, despite the high cost and relatively low success rate of the procedure. We identified characteristics that predict which vasectomy patients may request reversal. We also examined the cost and effectiveness of pre-vasectomy sperm cryopreservation followed by intrauterine insemination as an alternative method of achieving pregnancy.

Materials and Methods: We reviewed medical charts of 365 patients who underwent vasectomy and 290 who underwent vasectomy reversal between 1990 and 1997. Data were collected on patient age at the time of vasectomy, religion, occupation, wife employment status, number of marriages, number of children, reason for reversal, and number of years between vasectomy and reversal. Based on previously reported values, pregnancy rates and cost per successful pregnancy were estimated for vasectomy reversal surgery, and compared with a calculated cost per pregnancy for sperm cryopreservation and intrauterine insemination.

Results: Patient factors significantly associated with increased vasectomy reversal included younger age at time of vasectomy ($p < 0.001$) and a wife who worked outside the home ($p < 0.001$). Vasectomy reversal occurred 12.5 times more often (95% confidence interval [CI] 7.6 to 20.7) in men who underwent vasectomy in their 20s than in men who were older. Men whose wives were not employed requested reversal 0.48 times as often (95% CI 0.33 to 0.71) as those whose wives worked. Men who were younger at vasectomy tended to wait longer before reversal (median 10 years) than other patients ($p < 0.001$). At 10 years our calculated pregnancy rates and cost per pregnancy were 44% and \$12,727 for vasectomy reversal, and 41% and \$9,512 for intrauterine insemination with banked sperm (3 attempts).

Conclusions: Patients who requested vasectomy reversal most often chose voluntary sterilization at a younger age. We believe that younger men should be given better pre-vasectomy counseling. However, the success rate and cost-effectiveness of sperm cryopreservation before vasectomy, with subsequent intrauterine insemination, may make this nonsurgical alternative desirable for younger couples who choose vasectomy even when properly informed about reversal rates.

KEY WORDS: vasectomy, vasovasostomy, fertility, cryopreservation, insemination

More than 30 million couples in the United States, United Kingdom, India and China are using vasectomy as birth control.¹ Vasectomy represents 8% of all contraceptive methods used worldwide. The percentage is much higher in Australia, Canada, The Netherlands, New Zealand, Korea, United Kingdom and the United States.² About 500,000 vasectomies are performed in the United States every year. The number has remained constant in recent years but the number of requests for surgical reversal is increasing. Up to 6% of men who undergo vasectomy will request reversal.³ Vasectomy reversals by vasovasostomy or vasoepididymostomy are costly, with pregnancy success rates ranging from 30 to 76%.⁴⁻⁶

Accepted for publication January 22 1999.

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We identified patient characteristics that predict which patients may later request reversal. This information could be used to improve pre-vasectomy counseling, perhaps dissuading men at high risk of changing their minds and lowering the rate of costly reversal procedures. The characteristics traditionally believed to increase the risk of seeking a reversal are age younger than 30 years, few or no children, religion that condemns sterilization and interest in surgical reversal or sperm banking.⁷ We believed that it was necessary to challenge these traditional beliefs, as they are, outdated in light of advances made in reproductive technology and the sophistication of our patient population. We also assessed the success rate and cost-effectiveness of an alternative method of achieving pregnancy after vasectomy, that is intrauterine insemination with sperm banked before vasectomy. We determined whether sperm banking should be recommended to all or some vasectomy patients.

MATERIALS AND METHODS

Between 1990 and 1997, 365 patients underwent vasectomy for voluntary sterilization and 290 underwent vasovasostomy for vasectomy reversal. Data were collected on age at the time of vasectomy, religion, patient occupation, wife employment status, number of marriages, number of children, reason given for reversal, and number of years between vasectomy and reversal. Patient occupations were assigned to classes by investigators masked to group.

We also evaluated the cost and pregnancy rates associated with sperm banking and intrauterine insemination, and vasectomy reversal. Pregnancy rates for vasectomy reversal and intrauterine insemination were compared using data from a review of current literature. The cost per pregnancy was compared for surgical reversal and intrauterine insemination by calculating the cost of the intervention multiplied by the number of patients and divided by the rate of live deliveries attributed to the intervention. The cost is based on the surgical fee of the procedure. Pregnancy success rate data were based on research published by the Vasovasostomy Study Group.⁴ Intrauterine insemination cost per pregnancy was calculated as the cost of preparing and freezing 3 semen samples plus annual maintenance fees plus the cost of 3 cycles of intrauterine insemination. Obstetrical costs were not included. These calculations were based on the assumption that the female partner was healthy and younger than 39 years.

Univariate relationships between reversal and nonreversal data were analyzed with the Wilcoxon rank sum test for continuous or ordered variables and the chi-square test for discrete variables. Age was analyzed as a continuous variable but was also classified into groups to illustrate trends. Multivariate analyses were performed using logistic regression to determine variables significantly associated with reversal. Statistical significance was assumed at $p < 0.05$. Statistical computations were performed with computer software. Economic comparisons of vasectomy reversals and cryopreservation were based on 2 stages of calculations of pregnancy rate and cost per pregnancy.

The pregnancy rate for vasectomy reversal was based on the findings of a group of 1,469 men followed for a 2-year period.⁴ The summarized pregnancy rate was based on 4 intervals since vasectomy of 76% for less than 3, 53% for 3 to 8, 44% for 9 to 14 and 30% for 15 years, and these values were used to represent interval midpoints of 1.5, 5.5, 11.5 and 15 years. The y-intercept of 0 years since vasectomy was based on the 30% per cycle success rate of normal, healthy couples reported by Zinaman et al.⁸ The y-intercept value extrapolated this value to 24 months by the formula of $100 - 70\% \cdot 24 = 99.98\%$. The rate for cryopreservation was based on the Kaplan-Meier estimated rate of 40.66% pregnancies for 3 and 57.4% for 6 intrauterine insemination cycle rates.⁹ These values were used as constants throughout the post-vasectomy period. Although not the equivalent of 24 months of intrauterine insemination, 3 and 6 cycles represent typical use of intrauterine insemination methods.

The "average cost of pregnancy attempt" attributed to vasectomy reversal was \$5,600 per vasovasostomy. The costs of a pregnancy attempt using cryopreservation included \$960 initial cryopreservation fee and \$198 per year post-vasectomy cryopreservation maintenance costs for semen specimens. The average costs of intrauterine insemination cycles (\$264 per cycle) were also included for cryopreservation. The number of intrauterine insemination cycles included in the costs was based on expected values using success rates of Sidhu et al.⁹ For

example, a projected number of 3 intrauterine insemination cycles would be calculated using rates of 1% and 13% for the first 2 cycles. The resulting average value was $\$264 \times 18\% + \$528 \times 13\% + \$792 \times 69\% = \662.64 . The costs per pregnancy were calculated as average cost of pregnancy attempt divided by the pregnancy rate over the interval since pregnancy.

RESULTS

Multivariate logistic regression revealed that patient age at the time of vasectomy differed significantly between the vasectomy and reversal groups ($p < 0.001$). Vasectomy was performed at a mean age plus or minus standard error of 38.2 ± 0.3 years in men who did not desire reversal and at a mean age of 30.9 ± 0.4 in those who underwent reversal. Vasectomy reversals were performed most frequently in men who were 20 to 29 years old at the time of vasectomy ($p < 0.001$). As expected, vasectomy was done in most men when they were in their 30s. However, a relatively small number of men who underwent vasectomy in their 20s were 12.5 times more likely to undergo reversal (95% CI 7.6 to 20.7). The reversal and nonreversal groups were not different in terms of wife employment status. However, men whose wives were not employed outside the home requested reversal 0.48 times (or half) as often (95% CI 0.33 to 0.71) as those whose wives were employed (table 1).

Nearly all patients in both groups underwent vasectomy during the first marriage. There was no difference between groups in regard to the number of children per man or type of occupation. The religious affiliations in each group were similar, with about a third of all men being Catholic, about 12% being Protestant and the rest classified as other or none. Using Cox regression analysis age at the time of vasectomy and the reason for reversal (remarriage, median 9 years) were significantly related to the timing of reversal (median 6 years) compared with other reasons ($p < 0.001$). Men who had undergone vasectomy between ages 20 and 29 years were likely to elect reversal after a longer interval (median 10 years) than other patients ($p < 0.001$) (table 2).

Using data from the Vasovasostomy Study Group series we plotted the success rate of reversal against the interval between vasectomy and reversal up to 15 years. Success rates were 76% at less than 3, 53% at 3 to 8, 44% at 9 to 14 and 30% at more than 15 years.⁴ Based on previous research on healthy donor cryopreserved sperm and intrauterine insemination,⁷ we estimated an intrauterine insemination success rate of 41% after 3 and 57% after 6 cycles. Success rates for the 2 methods are plotted in figure 1.

Our institution charge for vasovasostomy is \$5,500, which is comparable to national rates.¹⁰ Using this figure we calculated the cost of alive delivery after reversal to be \$7,368 up to 3, \$10,566 between 3 and 8, \$12,727 between 9 and 14, and \$18,667 at more than 15 years after vasectomy. The cost of preparing and freezing 3 semen specimens was estimated at \$924, the annual maintenance fee for sperm banking \$198 and the charge for intrauterine insemination for 3 cycles \$663. The cost of each live delivery per 3 cycles of intrauterine insemination was calculated as median values of \$4,682 up to 3, \$6,615 between 3 and 8, \$9,512 between 9 and 14, and \$11,202 after 15 years (fig. 2).

DISCUSSION

Vasectomy is one of the most popular forms of long-term birth control worldwide because it is safe and cost-effective.^{11,12} However, a significant number of men later choose to reverse the procedure, despite the high cost of reversal and its variable success in restoring fertility. Better pre-vasectomy counseling might reduce the number of men who later elect reversals but the literature provides little or no discussion of counseling^{13,14} or guidance for identifying those who might later request vasectomy reversal. Under guidelines published by the Society for Voluntary Surgical Sterilization, a patient who expresses interest in the reversibility of vasectomy or in sperm banking is considered to be at higher risk for later regretting the vasectomy.⁷ Unfortunately, although this guideline may be accurate, it probably deters physicians from discussing either possibility during the pre-vasectomy counseling session.

Our study demonstrates that being vasectomized before age 30 years should be considered a risk factor for choosing vasectomy reversal. Despite the limitations of our retrospective study, in which the availability of patient data was restricted to the present decade, we were able to make reasonable observations. Others have also reported that the majority of men requesting reversal underwent vasectomy when they were younger than 35 years.^{1,15} Vasectomy reversal is requested most frequently because of divorce and remarriage.^{1,5,15} Other reasons for vasectomy reversal include the death of a spouse, the death of a child, a change of mind about family size and the desire to regain masculinity. Some have also noted that the risk of regretting a vasectomy was highest when the procedure was performed during an emotional crisis.¹ Post-vasectomy pain syndrome may occur in 3 to 8% of patients¹⁶ but reversals are rarely performed for this reason.

TABLE 1. Demographic characteristics of vasectomy and vasectomy reversal patients

Variable	No Reversal	Reversal	p Value	
			Univariate	Multivariate
No. employment classification:			0.06	0.13
Business/administration	108	78		
Professional	63	51		
Skilled labor	43	51		
Technical	67	44		
Miscellaneous white collar	25	27		
Public service/government	12	10		
Other	46	35		
Unemployed	12	1		
No. wife employment:			<0.001	<0.001
Employed	162	156		
Unemployed	153	67		
Unknown	49	67		
No. religion:			0.18	0.47
Catholic	138	90		
Protestant	46	37		
Other/none	181	163		
No. Reason for reversal:			Not Applicable	Not Applicable
Remarriage		222		
Other		68		
Mean age ± SE at vasectomy	38.2 ± 0.3	30.9 ± 0.4	<0.001	<0.001
No. age group:				
20-29	21	130		
30-39	209	136		
40-49	114	20		
50-59	20	4		
Older than 60	1	0		
Mean marriages ± SE	1.1 ± 0.02	1.0 ± 0.01	<0.001	0.09
No. marriages:				
None	1	0		
1	330	284		
2	24	3		
3	1	0		
Mean children ± SE at vasectomy	2.5 ± 0.1	2.4 ± 0.1	0.07	0.97
No. children at vasectomy:				
None	16	1		
1	34	38		
2	152	139		
3	110	57		
4 or More	47	32		

TABLE 2. Time since vasectomy (in years) for the total reversal sample and significant subgroups

Pt. Group	25th Percentile (95% CI)	50th Percentile (95% CI)*	75th Percentile (95% CI)
Overall	5 (4-6)	8 (8-9)	12 (11-13)
Reason for reversal:			
Remarriage	6 (5-7)	9 (8-10)	13 (12-14)
Other	3 (2.5-5)	6 (5-9)	11 (9-12)
Age at vasectomy:			
20-29	7 (6-8)	10 (9-11)	14 (12-15)
30-39	4 (3-5)	7 (6-8)	11 (10-12)
40 or Older	3 (1-4)	5 (3-7)	8 (5-10)

* Represents median value.

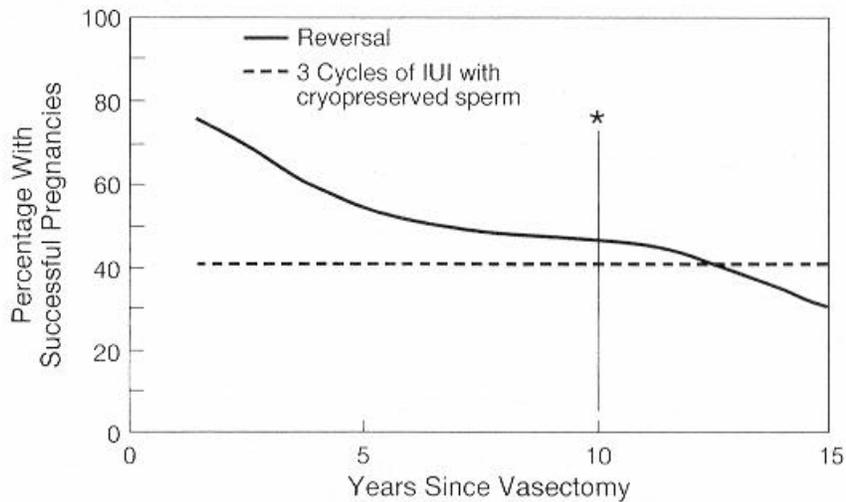


FIG. 1. Comparison of expected pregnancy rates during varying intervals since vasectomy for reversal and cryopreservation of semen with subsequent intrauterine insemination (IUI) for 3 cycles. Vertical line represents 10 years after vasectomy, which is median time for men 20 to 29 years old.

Although the difference between our 2 groups of patients in regard to number of children per man was not significant, the rate of vasectomy reversals increased as the number of children decreased. This relationship did not apply to men with no children. Contrary to traditional belief, our study suggests that men with no children at the time of vasectomy were less likely to undergo vasectomy reversal later. Thus, we believe that these men may represent a group who are highly motivated to remain childless.

We were surprised to find that men seeking vasectomy reversal were more likely to be married to women employed outside of the home, for which there are 2 possible explanations. From the beginning couples seeking vasectomy tend to be less traditional and more communicative,¹⁷ which is a value system consistent with a high rate of women working outside the home. In addition, couples with 2 incomes might be more able to afford vasectomy reversal and the cost of raising additional children. However, we acknowledge that this comparison may be inappropriate, as the spouses of men seeking vasectomy reversal are of a subsequent marriage. We hypothesized that religion may influence the risk for regretting sterilization, especially if the religion does not condone sterilization. In particular, being Catholic might be expected to increase that risk because Catholic doctrine forbids the procedure. However, we found similar religious demographics in both groups, with Catholicism predominating.

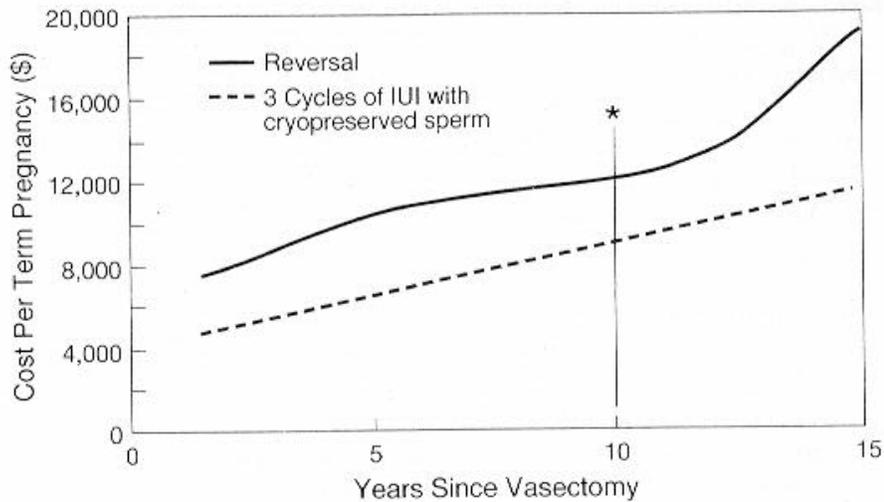


FIG. 2. Comparison of expected costs per pregnancy during post vasectomy interval for vasectomy reversal and cryopreservation of semen with subsequent intrauterine insemination (IUI) for 3 cycles. Vertical line represents 10 years after vasectomy, which is median time for men 20 to 29 years old. Increases in cost of vasectomy reversal with time are due to overall decrease in success rate, and increases in cost of cryopreservation of sperm and subsequent intrauterine insemination with time are minimal and due to annual cryopreservation maintenance fees.

We also explored the possibility of sperm banking before vasectomy for future intrauterine insemination. When contemplating vasectomy reversal, the patient and physician need to consider the probability of success in achieving pregnancy and the high cost. Success rates and costs can best be analyzed by studying cost per successful term pregnancy. This cost has been calculated to be as high as \$25,000 for vasovasostomy, \$31,000 for vasoepididymostomy and \$72,000 for intracytoplasmic sperm injection. However, these figures are much higher than our estimates because they included obstetrical costs.^{10,18}

We recommend sperm cryopreservation for high risk patients who choose vasectomy after complete and appropriate counseling. If a pregnancy is wanted later, the banked sperm can be used for intrauterine insemination. However, unlike vasectomy reversal surgery, the wife is the patient for intrauterine insemination and she may decide to limit its use for quality of life reasons, which is the reason we used 3 cycles for comparative purposes. Although the cost of this method is lower than that of vasectomy reversal, the pregnancy rate per cycle is sometimes lower. Also, success is low among women older than 37 years¹⁹ and patients with semen samples of low sperm motility (less than 40%).²⁰ Of course, these reported variables reflect a much different infertile population than our cohort of previously fertile, voluntarily sterilized men. We conservatively estimated the term pregnancy success rate after 3 cycles of intrauterine insemination to be 41%.⁹ Natural conception rates have been estimated to be 30% per cycle, with birth rates being much lower.⁸ Sperm cryopreservation and intrauterine insemination had an acceptable success rate in our study population and the cost per pregnancy was much lower than vasectomy reversal. Sperm banking should be particularly advantageous for younger vasectomy patients because if they seek reversal, they are likely to seek it after a relatively long interval (median 10 years), which reduces the chances of successful reversal surgery.

In this era of advanced reproductive technology and pressures to contain health care costs, we believe it is essential to redefine informed consent for vasectomy. Counseling of patients seeking permanent sterilization must be done by primary care providers, as helping patients choose a form of contraception is considered vital for family physicians.⁷ Physicians providing family planning services, including family practitioners, internists, obstetricians and gynecologists, urologists and general surgeons,¹² should learn to screen patients seeking sterilization, in particular to recognize those at higher risk for seeking vasectomy reversal. Traditionally, an interest in sperm banking or reversal

was a contraindication for permanent sterilization. However, we believe that this guideline has led physicians providing vasectomy services to avoid discussing these alternatives altogether. We also believe that failing to address these issues regardless of patient inquiry should be considered failure to provide counseling adequate for informed consent. Not only should these alternatives be discussed, but sperm banking should be recommended to men younger than 30 years.

CONCLUSIONS

Patients requesting vasectomy reversal tend to have undergone vasectomy at a young age. Our findings clearly demonstrate the importance of pre-vasectomy counseling and informed consent. Patients contemplating vasectomy should be made aware of the high cost of reversal surgery and the difficulty of ensuring fertility after reversal. We believe that young men should receive particularly thorough counseling about other birth control methods and, if they still choose to pursue vasectomy, sperm banking should be strongly recommended. Higher rates of reversal in men whose wives were employed may reflect cultural or economic phenomena that may be unique to the United States or industrialized countries, and so this finding may not be relevant in other societies. Finally, recommending cryopreservation of sperm to men younger than 30 years could potentially translate into significant cost savings.

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EDITORIAL COMMENT

Vasectomy remains a popular form of contraception in this country and around the world despite multiple hits during the years, including studies suggesting an increased risk of atherosclerosis and prostate cancer associated with vasectomy. The authors make a valiant effort to identify those individuals undergoing vasectomy who are most at risk for requesting a reversal. As expected, youthfulness at the time of vasectomy is the major risk factor since this population has the longest exposure to the main reason for vasectomy reversal, which is divorce and remarriage. However, the cohort analysis used in this study provides only a relative risk for vasectomy reversal. Identification of individual absolute risk for vasectomy reversal would require a population based prospective study, which is extremely difficult to perform. The current best estimates for the absolute risk for vasectomy reversal, as stated by the authors, are less than 10%.

The authors suggest that young couples should be encouraged to cryopreserve sperm for later use if they have a change of mind, based on their economic comparison of surgical vasectomy reversal and intrauterine insemination using cryopreserved sperm. However, their economic comparison did not include the cost of sperm cryopreservation for individuals who do not desire more children, which might be more than 90% of the patients undergoing vasectomy. Moreover, sperm storage fees would extend for an indeterminate, theoretically infinite, amount of time for this cohort. Although I agree with the practice of routinely offering sperm cryopreservation to men undergoing vasectomy, my clinical experience is that men rarely want to spend the extra money for sperm cryopreservation when they are "certain" that they do not want to father more children. Sperm cryopreservation is not a covered health care expense, and those who need it most are frequently least able to afford it.

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REPLY BY AUTHOR

We acknowledge the limitations of our economic comparison but wish to remind the readers that sperm cryopreservation is not indefinite. Patients are informed about their right to request thawing and destruction of specimens at any time. Ironically, we also find that patients who may be at highest risk for "vasectomy regret" are those who are least interested in sperm cryopreservation. Hopefully, our data can help improve our pre-vasectomy counseling and more appropriate, selective sperm banking.