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Original Article

Association between the lengths of excised obstructed vas deferens segments at the time of vasovasostomy and surgical outcomes

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ABSTRACT

Objective: This study aimed to determine whether the length of the excised obstructed vas deferens at vasovasostomy (VV) performed for fertility is associated with semen parameters and/or pregnancy outcomes postoperatively.

Material and methods: The patients who underwent a VV at our institution from September 2004 to December 2018 were contacted via questionnaire and a chart review was performed. Linear and logistic regression models were used to determine the associations between the length of the obstructed vas deferens removed and postoperative outcomes including sperm concentration, motility, and successful pregnancy after reversal.

Results: A total of 83/170 questionnaires were returned. After exclusions, a total of 35 patients were included for analysis. The mean age of the patients at the time of surgery was 40.1 years and the mean time since vasectomy 9.3 years. The mean length of the obstructed vas deferens removed during VV was 2.25 cm. The longer the vas deferens segments removed, the more significant was the increase in sperm motility at 3 and 9 months postoperatively (p=0.011 and 0.008, respectively), but decreased sperm motility at 6 months (p=0.029). In 75.9% of the patients, sperm was present postoperatively, 23.2% achieved pregnancy through natural conception, and 55.8% achieved pregnancy using assisted reproductive techniques. There was no significant relationship between the length of the vas deferens removed and sperm concentration or pregnancy achieved after surgery.

Conclusion: In this cohort, the length of the excised obstructed vas deferens at VV was associated with improved sperm motility at 3 and 9 months postoperatively but not with pregnancy outcomes.

Keywords: Infertility; obstructive azoospermia; vas deferens; vasovasostomy.

Introduction

Bilateral vasectomies are one of the most commonly performed procedures by urologists and across all medical specialties, with over 500,000 men in the United States undergoing vasectomy each year.[1] However, up to 6% of the men who previously had a vasectomy will ultimately desire a vasectomy reversal because of factors such as separation from previous partner, desire to have more children with the same partner, or other various reasons.[2] These men may elect to proceed with vasovasostomy (VV) or vasoepididymostomy (VE) for restoring fertility. While multiple other assisted reproductive techniques now exist, VV and VE both provide a means of attempting natural conception and a cost effective option compared with *in vitro* fertilization or intracytoplasmic sperm injection.[3]

Earlier studies have reported excellent patency rates of greater than 90% following VV or VE (patency rates after VE were reported to vary from 27%-92%).[4-7] However, reported success rates as defined by a successful pregnancy after VV vary widely among studies from 22%-72%.[5] Studies have also demonstrated factors impacting the success rate of VV or VE, including numerous potential predictive variables such as obstructive time interval, identification of intraoperative motile sperm, age of the female partner, and attempting conception with the same female partner who has had a prior successful pregnancy.[8-10]

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Various surgical approaches exist and have been described for performing vasectomy reversal. Over the past few decades, VV and VE have been commonly performed with the operating microscope and more recently via robotically-assisted approaches.[11] Anastomosis can be performed using single and multi-layer techniques or other methods; however, the goal is to achieve a tension-free, mucosa to mucosa anastomosis with adequate blood supply. Regardless of the approach or technique, during VV or VE for obstructive azoospermia following vasectomy, the previously ligated segment of the vas deferens is typically excised prior to performing anastomosis with healthy tissue. No prior studies have analyzed the length of the removed obstructed vas deferens segment and its association with vasectomy reversal outcomes. We sought to investigate whether an association exists between the obstructed vas deferens segment length removed at time of VV and postoperative outcomes, including semen parameters and overall pregnancy success. We hypothesized that the need to excise a longer segment of vas deferens would be a poor prognostic indicator for postoperative outcomes.

Material and methods

Ethics committee approval

Ethics approval was undertaken through the institutional review board (IRB) at the University of Iowa. This study was first approved on 7/17/2017 through identification #201707757. All the patients who underwent VV and VE by a single surgeon at our institution from 2004 to 2018 were identified. After IRB approval, these patients were mailed survey questionnaires, and each patient was provided information regarding the risks and benefits of participating in the survey and the study as a whole. Written informed consent of the patients was returned with the survey.

Surgical approach

All the VV and VE procedures were performed using an operating microscope. The obstructed segment of the vas deferens was isolated, excised sharply, and the lengths excised bilaterally were recorded in the operative reports. A 2-layer anastomosis was performed in all VV cases, approximating the mucosal layers with interrupted 10-0 Nylon sutures (Sharpoint Microsuture, Surgical Specialties Corporation, Tijuana, Mexico) and seromuscular layers with interrupted 9-0 Nylon sutures (Sharpoint Microsuture, Surgical Specialties Corporation, Tijuana, Mexico).

Main Points:

- The association among the length of the excised vas deferens at the time of vasovasostomy, postoperative outcomes, and pregnancy rates has not been established.
- Longer lengths of the excised obstructed vas deferens segments at the time of vasovasostomy was associated with improved sperm motility at 3 and 9 months postoperatively, but not at 6 months.
- The excised length of the vas deferens was not associated with a successful pregnancy.
- Surgeons should continue to focus on removal of the adequate vas deferens length to reapproximate healthy tissue under a tension-free anastomosis.

Data collection

The patients in the cohort were sent a questionnaire in the mail which asked for the patients to report whether conception had occurred after their procedure. For the patients who returned the questionnaire, a chart review was then performed to determine patient data including the age of the male and female partners at the time of reversal, time since vasectomy, operative time, lengths of vas deferens excised, postoperative semen parameters, and any complications following the procedure. Exclusion criteria included any patients who received VV for indications other than infertility or if the length of the obstructed vas deferens segments were not recorded at the time of surgery. The patients who underwent VE were also excluded prior to the statistical analysis because only 1 patient who had VE responded to the questionnaire. There were no known female fertility factors in the cohort. Semen analyses were performed according to the most updated World Health Organization criteria at the time of testing,[12] at either the University of Iowa or local laboratories per the patient preference. The semen analysis results included in this study were sperm concentration (10^6/mL) and total motility (%).

Statistical analysis

Linear and logistic regression models were created to fit for continuous and binary outcomes, respectively, to assess the correlation between mean length of the obstructed vas deferens segments removed (cm) and postoperative outcomes including semen analysis results at 3, 6, and 9 months postoperatively, successful pregnancy after reversal, and overall pregnancy (which also included pregnancies via assisted reproductive techniques). The model was controlled for the following possible confounding predictors including age at the time of reversal: female partner's age at the time of reversal, time since vasectomy, and operative time. Full models with all predictors were fit, and stepwise selection based on Akaike Information Criterion was used for model selection with segment length forced into all models. Statistical analysis was performed with the statistical analysis system (SAS) v9.4 (SAS Institute, Cary, NC, USA).

Results

We sent 170 surveys to the patients who underwent VV and VE from 2004 to 2018 by a single surgeon at our institution. A total of 83 completed questionnaires (49%) were returned. We ex-

cluded 39 patients who did not have the excised vas deferens length noted in the operative report. An additional 9 patients were excluded who either had VE or VV performed for indication other than fertility or if there were incomplete data for analysis (including lack of demographic information, partner information, or semen analyses). After these exclusion criteria were applied, a total of 35 patients were included in the analysis. Patient demographic information is included in Table 1. The mean male age at the time of surgery was 40.1 years (SD±6.7) with the mean time since vasectomy of 9.3 years (SD±6.0). The mean length of the obstructed vas deferens segment removed during vasovasostomy was 2.25 cm (SD±0.9). The mean lengths excised in patients who would ultimately achieve any postoperative patency or pregnancy were 2.24 cm (SD±0.9) and 2.23 cm (SD±0.9), respectively. Postoperative semen analyses were performed at the University of Iowa Reproductive Laboratory for 25/35 (71%) of the patients, and the remainder at local laboratories. Across all time periods, 75.9% of the patients demonstrated patency with sperm present on analysis. Linear and logistic regression models revealed that a longer vas deferens segment removed was significantly associated with an increase in sperm motility at 3 and 9 months after surgery (p=0.011 and 0.008, respectively; Table 2, Figure 1). We found the opposite association at 6 months, when a longer vas deferens segment removed was significantly associated with a decrease in sperm motility (p=0.029). There was no significant relationship between the length of the vas deferens removed and sperm concentration at any time point. The overall conception rate with the use of assisted reproductive techniques was 55.8% and without assisted reproductive techniques was 23.2% (Table 2, Figure 2). The length of obstructed vas deferens segment removed was not significantly associated with pregnancy achieved after surgery with or without assisted reproductive techniques.

Table 1. Patient characteristics and postoperative outcomes after vasovasostomy

Patient characteristics	**N=35**
Mean age±SD at the time of reversal (years)	40.1±6.7
Mean age±SD of female partner (years)	33.2±5.8
Mean time±SD since vasectomy (years)	9.3±6.0
Mean operative time±SD (minutes)	203±27.4
Mean vas segment removed±SD (cm)	2.25±0.9
Patients with postop patency	2.23±0.9
Patients with postop pregnancy	2.24±0.9
Outcomes	
3-month mean sperm concentration±SD (10^6/mL)	18.6±26.5
3-month patency (%)	69.2
3-month mean sperm motility±SD (%)	22.2±24.7
6-month mean sperm concentration±SD (10^6/mL)	11.1±21.3
6-month patency (%)	58.8
6-month mean sperm motility±SD (%)	16.7±21.2
9-month mean sperm concentration±SD (10^6/mL)	9.8±16.8
9-month patency (%)	58.3
9-month mean sperm motility±SD (%)	15.7±20.7
Any patency (%)	75.9
Pregnancy after vasovasostomy (%)	23.2
Overall pregnancy, including ART (%)	55.8
Mean time to pregnancy±SD (months)	7.4±7.2

SD: standard deviation; ART: assisted reproductive techniques

Discussion

Vasectomy is a commonly performed procedure by urologists and family physicians. Up to 6% of the men who have had a vasectomy will elect for vasectomy reversal for a variety of reasons, including the desire to regain fertility. Multiple prior studies have detailed predictive factors for success following vasectomy reversal, but to our knowledge, no prior study has assessed the association between the length of the excised obstructed vas deferens and either postoperative semen parameters or postoperative conception. We hypothesized that the need to remove a longer segment of obstructed vas deferens would have a negative impact on the success of vasectomy reversal. However, based on this cohort of men who underwent VV for restoring fertility, a longer excised vas deferens segment had no effect on conception rates postoperatively. A longer excised vas deferens segment at the time of VV was significantly associated with an increase in sperm motility at 3 and 9 months after surgery; however, but the opposite was true at 6 months. These findings have several implications for the management of men who desire fertility following a vasectomy.

Table 2. Effect of mean length of the excised vas deferens (cm) on postoperative semen parameters and pregnancy

Outcome	**Estimated effect (SE)**	**p**
3-month sperm concentration	1.6 (10.20)	0.88
3-month sperm motility	20.5 (7.15)	0.011*
6-month sperm concentration	3.7 (13.71)	0.795
6-months sperm motility	–16.8 (6.29)	0.029*
9-month sperm concentration	25.1 (17.31)	0.198
9-months sperm motility	55.4 (14.02)	0.008*
Pregnancy after reversal	0.14 (0.48)	0.774
Pregnancy overall	0.50 (0.51)	0.194

SE: standard error. Effect is an estimated factor (positive or negative) based on increasing 1 cm length of excised segment.

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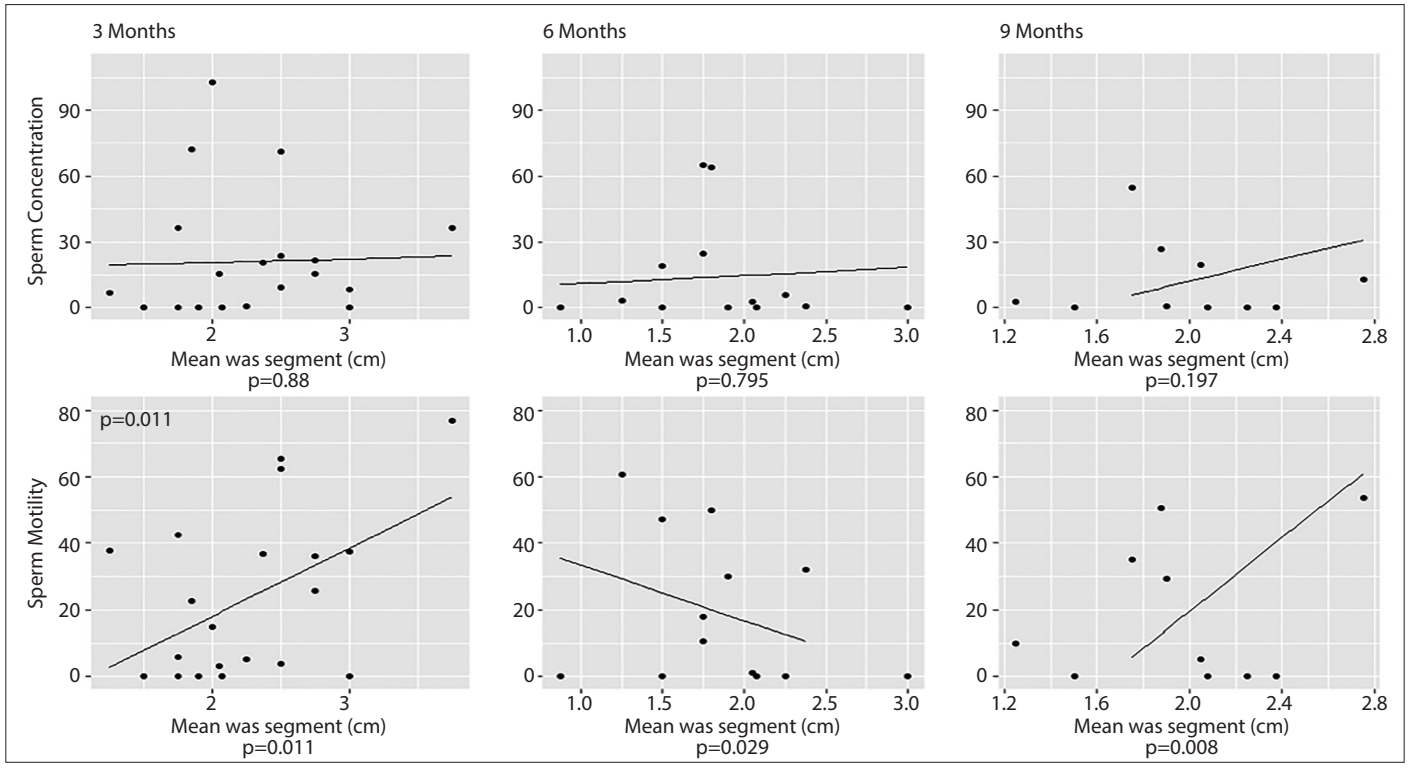

Figure 1. Effect of the mean length of excised vas deferens (cm) on postoperative sperm concentration and total motility at 3, 6, and 9 months follow-up

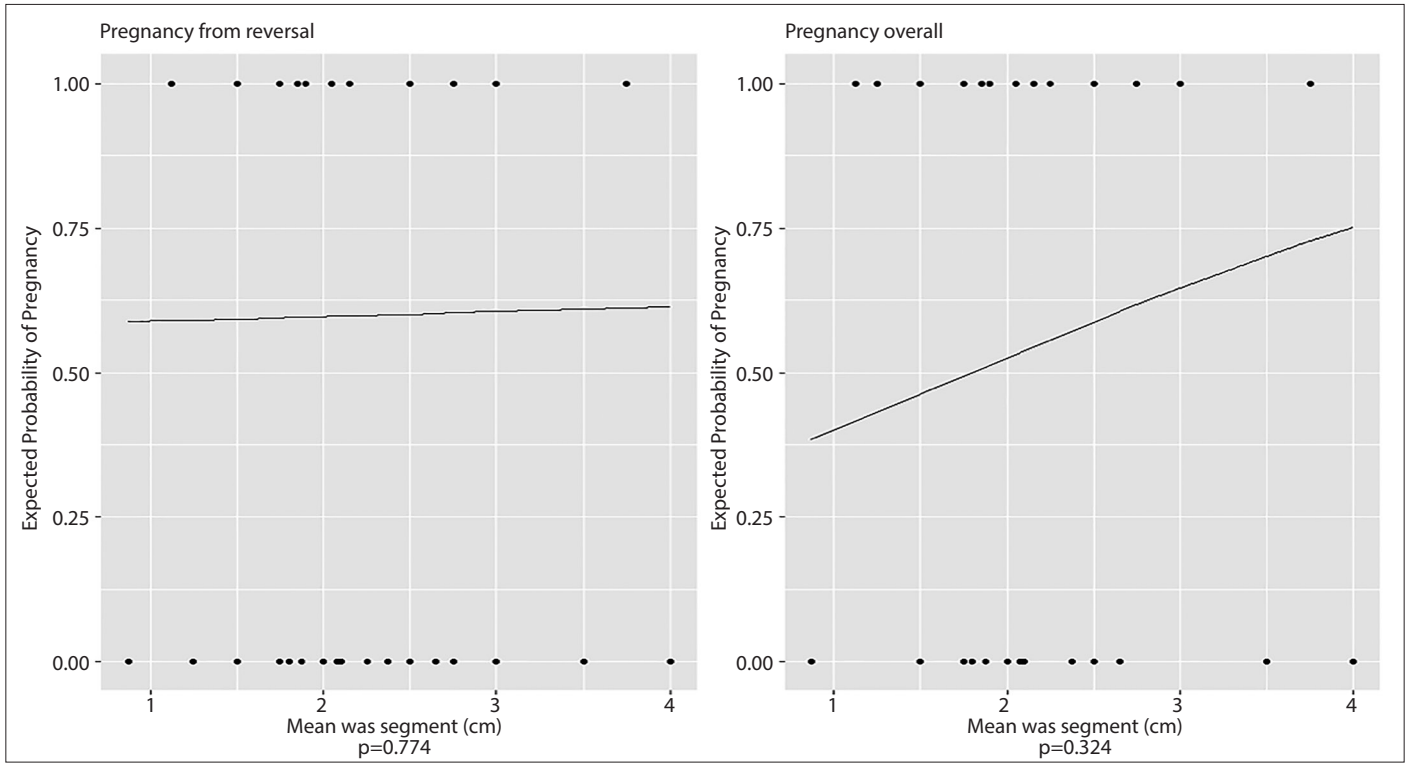

Figure 2. Effect of mean length of excised vas deferens (cm) on postoperative pregnancy

We expected that removing longer segments of obstructed vas deferens (reflecting a longer gap to be bridged during vasectomy reversal) could lead to suboptimal surgical results because of the greater degree of tissue changes and more difficulty in achieving a tension-free anastomosis. Our results showed that this was not the case. The non-inferiority of the longer excised vas deferens lengths compared with shorter segments confirms that our surgical goal should continue to be to excise sufficient length to reach healthy, viable vas deferens on both the proximal and distal aspects. Assuming a tension-free anastomosis can still be achieved, removal of marginally more obstructed vas deferens did not limit the ultimate success of achieving pregnancy after repair. Furthermore, we observed significantly better sperm motility at 3 and 9 months postoperatively in those patients who had longer segments removed. One explanation for these findings is that the patients who had longer lengths of vas deferens removed had a more complete excision of scar tissue and therefore healthier tissue incorporated into the VV anastomosis. However, we did not appreciate this association across all time periods. Sperm motility at 6 months after surgery was significantly worse, which makes the interpretation of this relationship more difficult. Regardless, the ultimate outcome measure of importance, achieving pregnancy, was not affected. Additional vas deferens length removal was non-inferior for pregnancy outcomes in this group of patients.

Our study has several limitations that must be considered. This study retrospectively analyzed a relatively small sample size of 35 patients from an initially selected group of 170. This sample size could limit the power to detect clinically significant differences. Because this was a single surgeon cohort, we feel that operative factors are fairly homogenous. The retrospective nature of this study did not allow any randomization of the length of vas deferens that was excised but rather relied on intraoperative factors and decision making to determine the length. We had to rely on the patients to accurately recall information for their questionnaire responses, but this was primarily related to achieving a successful pregnancy which could be considered a major life event most patients would reliably recall. Owing to having only one response from a patient status post VE, we did not include VE in our analysis; and therefore, our findings might not be generalizable to that population. The most important outcome measure for this study and most of our patients is the achievement of pregnancy. A vast number of variables can affect the success or failure of pregnancy. Our models were not completely exhaustive. Vasal fluid quality at the time of reversal was included in some, but not all operative reports, and the data were qualitative in nature so these were not included as controlling factors. However, our model did include important possible confounding variables, including the ages of the female and male partners, time since vasectomy, and operative time.

In conclusion, VV is a technically challenging procedure with good reported rates of postoperative patency but widely varying successful pregnancy rates. In this single-surgeon cohort, the length of the excised obstructed vas deferens segments at time of VV was associated with improved sperm motility at 3 and 9 months postoperatively; however, it was not associated with a successful pregnancy.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of University of Iowa (7/17/2017 through identification #201707757).

Informed Consent: Written informed consent was obtained from patients who participated in this study.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept – M.W.; Design – M.W., J.W.; Supervision – M.W.; Resources – M.W., J.W., C.P.; Data Collection and/or Processing – J.W., C.P.; Analysis and/or Interpretation – M.W., J.W., C.P.; Literature Search – M.W., J.W., C.P.; Writing Manuscript – C.P., M.W.; Critical Review – M.W., C.P.

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