ADVANCES IN ASSISTED REPRODUCTIVE TECHNOLOGIES

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MICROSURGERY, ANDROLOGY, AND ITS ROLE IN IVF

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I. PREGNANCY AFTER VASOVASOSTOMY FOR VASECTOMY REVERSAL: FACTORS AFFECTING LONG TERM RETURN OF FERTILITY IN 282 PATIENTS FOLLOWED FOR TEN YEARS

INTRODUCTION

Vasectomy is the most popular method of birth control in the world today.[22] More than a half million vasectomies are performed in the United States each year. Because of fear of child death in the developing world, changing views about family life in the western world, and the increasing prevalence of divorce and remarriage, there is now a large number of men requesting reversal of vasectomy. For many years the pregnancy rate after surgical reanastomosis of the vas had been very low, and a variety of explanations had been offered for the relatively poor success in reversing vasectomy.[9,10,23,25,31] With the advent of microsurgical techniques pregnancy rates improved considerably, suggesting that purely micro-mechanical factors were associated with the low success rates, but long-term follow-up on large numbers of patients were not available and the matter remains somewhat controversial.[36,38] Theories for the consistently poor results with vasectomy reversal have included development of sperm antibodies, damage to the deferential nerve, and testicular damage.[4,8,12,19,21,24,28,50] Yet some investigators questioned any correlation between sperm antibodies in the serum and subsequent fertility after vasovasostomy,[52] and the effect, if any, of vasectomy on the testis in humans and animals has also been very controversial.[40] Segregating the various studies by species has not cleared up the confusion. If any testicular damage occurs, the generally agreed upon mechanisms would be either autoimmune, or pressure related.[1,6,7,18,30,40]

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Table 1. Overall Long-term Pregnancy Rates in Patients undergoing Vasovasostomy. Ten Years Follow-up (Sperm seen in Vas Fluid)

	Combined 1975 and 1976-1977 Series	Original 1975 Series
Total Patients	282 (100%)	42 (100%)
Total Pregnant	228 (81%)	32 (76%)
Azospermic	24 (9%)	5 (12%)

The pressure increase subsequent to vasectomy has been well established, as well as the effect of this pressure on epididymal dilatation, perforation and sperm inspissation in the epididymis, causing secondary epididymal obstruction.[38, 41, 42] We found that the incidence of this confounding secondary epididymal blockage increased with the duration of time since vasectomy, and never occurred if there was a sperm granuloma at the vasectomy site.[36, 37, 40] Despite the dismal finding of no sperm in the vas fluid in patients with secondary epididymal blockage, the testicle biopsy always appeared normal.[41, 47] This apparent effect of pressure increase after vasectomy led to a suggestion that the testicular end of the vas not be sealed at the time of vasectomy, so as to lessen the pressure build-up, and possibly increase the ease of reversibility (notwithstanding the potentially damaging immunological consequences.[2, 34, 37] We wished to determine with the present study what the fertility rate would be for this favorable group of patients who had no epididymal damage as evidenced by sperm being present in the vas fluid.

We have carefully studied for nine to ten years a large group of patients who have undergone microsurgical vasovasostomy with no evidence of pressure induced secondary epididymal blockage. We attempted to relate in these patients presence or absence of varicocoele, post-operative semen analyses, pre-operative serum sperm antibody titers and quantitative evaluation of testicular biopsy to the chance for pregnancy. In this study we are reviewing the results in patients who were thought to have no epididymal blockage. Patients with no sperm in the vas fluid, all of whom exhibited secondary epididymal obstruction, will be the subject of a subsequent paper.

CONCLUSIONS

We wished to determine the eventual fertility of those vasectomy reversal patients who have no pressure induced secondary epididymal blockage. These patients underwent simple vasovasostomy because at the time of the reversal surgery, there were sperm present in

Table 2. Pregnancy Rate according to Distribution of Motile Sperm Count in Men with Sperm Patency following Vasovasostomy (Ten Year Follow-up)

Total Motile Sperm Count (per ejaculate)	Total Patients	Pregnant	Not Pregnant
0-10,000,000	32 (12%)	25 (78%)	7
10-20,000,000	31 (12%)	27 (87%)	4
20-40,000,000	32 (12%)	30 (93%)	2
40-80,000,000	79 (31%)	68 (86%)	11
80,000,000	84 (33%)	78 (92%)	6
TOTALS	258 (100%)	228 (88%)	30

Table 3. Pregnancy Rate according to % Sperm Motility in Men with Sperm Patency following Vasovasostomy (Ten Year Follow-up)

Motility	Total Patients	Pregnant	Not Pregnant
0-20	24	18 (75%)	6
20-40	70	66 (94%)	4
40-60	82	71 (86%)	11
60-80	62	55 (88%)	7
80	20	18 (90%)	2
TOTALS	258 (100%)	228 (88%)	30 (100%)

large numbers in the vas fluid. If there were no sperm in the vas fluid, the patients were excluded from the vasovasostomy series, and instead underwent vasoepididymostomy (see next section). We were able to obtain long-term follow up on 282 patients with sperm in the vas fluid who underwent vasectomy reversal eight to ten years ago. These patients were studied for pregnancy rate, post-operative semen parameters, duration of time since vasectomy, pre-operative serum antisperm antibody titers, the influence of varicocoele, and quantitative evaluation of testicle biopsy. All of the 44 patients with no sperm in the vas fluid who underwent vasovasostomy ten years ago remained azoospermic. Of the 282 patients with sperm in the vas fluid 228 (81%) eventually impregnated their wives. Twenty-four patients with sperm in the vas fluid (9%) were azoospermic and did not impregnate their wives. Of the 258 patients who had sperm patency, the pregnancy rate was 88% (Tables 1-5).

The number of mature spermatids per tubule in the testis correlated closely with the post-operative sperm count in patent cases. Quantitative evaluation of the testicle biopsy revealed normal spermatogenesis even in patients with azoospermia or severe oligospermia post-operatively. Failures were thus found to be due to blockage, either at the vasovasostomy site, or epididymal blockage unrecognized at the time of vasovasostomy. Sperm count

Table 4. Lack of Effect of Varicocoele (not operated on) on Pregnancy Rate following Vasovasostomy

	Number Patients	Patients With Varicocoele	Patients Without Varicocoele
Pregnant	228 (80.9%)	33 (78.5%)	195 (81.2%)
Not Pregnant	54 (19.1%)	9 (21.4%)	45 (18.8%)
TOTALS	282 (100%)	42 (14.8%)	240 (85.2%)

Table 5. Relationship of Serum Sperm Antibody Titers to Pregnancy Rate following Vasovasostomy

	Total Studied	Immobilizing Titre (Isojima)		Agglutinating Titre (Kibrick)	
		2	10	0	20
Husband Not Azospermic:					
Wife Pregnant	75	29 (39%)	18 (24%)	42 (56%)	30 (40%)
Wife Not Pregnant	11	1 (36%)	2 (16%)	6 (54%)	6 (54%)
Husband Azospermic	12	5 (42%)	3 (25%)	7 (58%)	5 (42%)
Entire Group Studied	98	38 (39%)	23 (24%)	56 (57%)	41 (42%)

had a minimal impact on the likelihood of pregnancy so long as there was patency, and there was no discrepancy between sperm count and actual testicular sperm production as determined by testicle biopsy.[47] Pregnancy was not related to presence or absence of a varicocoele, pre-operative serum sperm antibody levels, or testicle biopsy findings.

II. RESULTS OF MICROSURGICAL VASOEPIDIDYMOSTOMY: ROLE OF EPIDIDYMIS IN SPERM MATURATION

One hundred and ninety early patients with obstructive azoospermia caused by bilateral epididymal blockage have been followed for six years or longer after undergoing "specific tubule" vasoepididymostomy. At that time, we always attempted to perform the epididymal anastomosis as distally as possible so as to allow the greatest amount of epididymal length for sperm maturation. Thus the cases of vasoepididymostomy to the caput were more se-

Table 6. Corpus Epididymis: Lack of Relation of Post-op Spermatozoa Count to Pregnancy Rate

Spermatozoa Count (per cc)	Pregnant	Not Pregnant
Azospermic	0 (0%)	30
0 to 1 x 10^6	2 (67%)	1
1 to 5 x 10^6	5 (63%)	3
5 to 10 x 10^6	11 (65%)	6
10 to 20 x 10^6	6 (50%)	6
20 to 40 x 10^6	17 (81%)	4
40 x 10^6	32 (74%)	11
Unknown	5	0
	78 (56%)	61

Summary Footnote:

Patency Rate	78%
Overall Pregnancy Rate	56%
Pregnancy Rate in "Patent" Cases	72%

verely diseased and had a greater number of blockages than the more common case of vasoepididymostomy to the corpus (Tables 6-15).

When anastomosis was performed at the corpus epididymidis, the "patency" rate was 78%, and the overall pregnancy rate was 56%. The pregnancy rate for "patent" cases was 72%, indicating that a high fertility rate can be obtained with spermatozoa that have not transited the full length of corpus epididymidis. By contrast, with vasoepididymostomy to the caput epididymidis there was a 73% "patency" rate, but the overall pregnancy rate was only 31%. The pregnancy rate for "patent" cases was 43%. Spermatozoa from the corpus epididymidis had a higher rate of fertility than spermatozoa from the caput epididymidis, but spermatozoa from proximal areas of the corpus have no less fertility than spermatozoa from the distal corpus epididymidis. The most remarkable observation was that in almost half the cases of caput anastomosis, spermatozoa which have never journeyed beyond the caput epididymidis were capable of causing pregnancy.

We now routinely perform all anastomoses at the caput for reasons I will now explain. We do not yet have data on vasoepididymostomy performed routinely at the caput epididymis for *all* cases of epididymal obstruction, but we suspect there will be no difference in the fertilizing potential of sperm from anywhere along the epididymal tubule, if all other factors are equal. By performing all anastomoses at the caput we anticipate remarkable im-

Table 7. Corpus Epididymis: Relation of % Directional Spermatozoa Motility to Pregnancy Rate in "Patent" cases

% Directional Motility	Pregnant	Not Pregnant
0 - 19	13 (48%)	14
20 - 39	18 (75%)	6
40 - 60	19 (76%)	6
60	22 (81%)	5

Table 8. Corpus Epididymis: Lack of Relation of Age of Wife to Pregnancy Rate in "Patent" Cases

Age Of Wife	Pregnant	Not Pregnant
25	14 (78%)	4
25 - 29	30 (68%)	14
30 - 35	30 (75%)	10
35	4 (67%)	2

provement in success rate. This runs counter to current dogma, and requires some explanation, as follows.

Epididymal Physiology: Is the Epididymis Just a Long Stupid Tube?

Because of advances in microsurgical techniques, it is now possible to bypass most cases of epididymal obstruction with a high incidence of technical success.[38, 42, 43] The fertilizing capacity of spermatozoa which have not traversed all sections of the epididymis can ideally be studied with this human clinical model. In every animal that has been studied, spermatozoa from the caput epididymidis are only capable of weak circular motion at most, and are not able to fertilize.[27] Spermatozoa from the corpus epididymidis can occasionally fertilize but the pregnancy rate is low.

But few of these previous animal studies allowed the spermatozoa time to mature and thereby possibly develop fertilizing capacity. Spermatozoa were simply aspirated from specific regions of the epididymis, and then promptly inseminated. In most studies where the epididymis was ligated to determine if time alone could allow spermatozoa maturation, the obstructed environment was so pathological that no firm conclusions could be reached.[13, 15, 29]

Table 9. Corpus Epididymis: Lack of Reltion of level of Corpus Epididymal Anastomosis to Pregnancy Rate in "Patent" Cases

	Pregnant	Not Pregnant
Proximal Corpus	7 (88%)	1
Mid Corpus	17 (74%)	6
Distal Corpus	54 (71%)	22

Table 10. Corpus Epididymis: Percent Pregnant at Varying Intervals Post-op in Relation to Sperm Count in "Patent" Cases

Sperm Count ($x10^6$ per cc)	6 Months	12 Months	18 Months	24 Months	24 Months
1 - 5	56%	22%	22%		
5 - 10	63%	25%		13%	
10 - 20	17%	49%		17%	17%
20 - 40	44%	28%	11%	11%	6%
40	34%	28%	6%	9%	22%
100%	41%	29%	8%	10%	12%

In 1969, Orgebin-Crist[27] pointed out that we still did not know with certainty from any of these animal studies whether the factors governing the maturation process of spermatozoa are intrinsic to the spermatozoa themselves and just require time, or whether spermatozoa must transit through most of the epididymis in order to mature. It was entirely possible that aging alone might mature the spermatozoa, and that spermatozoa might not need to pass through all of the epididymis in order to develop the capacity to fertilize. Yet because of the animal studies alluded to, and poor results in humans using non-microsurgical techniques, it has always been assumed that epididymal blockage carries a poor prognosis.[3, 16, 17, 32]

As far back as 1931, however, Young's[53] experiments in guinea pigs with ligation at various levels of the epididymis indicated to the contrary: "that the time consumed by spermatozoa in passing through the epididymis is necessary for a completion of their development, that the changes undergone during this period represent a continuation of changes which start while the spermatozoa are still attached to the germinal epithelium, and are not conditioned by some specific epididymal secretion. In fact he observed the same "inversion" of regions of sperm motility and non-motility in the obstructed epididymis that we have

Table 11. Corpus Epididymis: Lack of Relation of Sperm Count to Mean Time till Pregnancy in "Patent" Cases

Sperm Count $X10^6$ per cc	Mean Time Till Pregnancy
1 - 5	6.7 months
5 - 10	6.0 months
10 - 20	10.5 months
20 - 40	4.3 months
40	6.4 months

Table 12. Head of Epididymis: Relation of Pregnancy to Sperm Motility in 37 Cases with Patency

% Sperm Motility	Pregnancy Rate	Pregnant	Not-Pregnant
0 - 20%	15%	2 (13%)	11 (52%)
20%	58%	14 (87%)	10 (48%)
TOTALS	43%	16 (100%)	21 (100%)

Table 13. Head of Epididymis: Relation of Age of Wife to Pregnancy Rate in Cases with Patency

Age of Wife	Pregnancy Rate	Pregnant	Not-Pregnant
25 - 30	67%	12 (75%)	6 (29%)
30	21%	4 (25%)	15 (71%)
TOTALS	43%	16 (100%)	21 (100%)

Table 14. Head of Epididymis: Lack of Relation of Level of Successful Vasoepididymostomy to Previous Failure

	PREGNANT	NOT PREGNANT
Redo After Previous Failure	6 (38%)	10
Virgin Case	10 (29%)	25

Table 15. Head of Epididymis: Relation of Post-op "Patency" to Area of Anastomosis at Head of Epididymis

	PROXIMAL CAPUT	MID CAPUT OR MIXED	DISTAL CAPUT
"Patent"	9 (53%)	10 (71%)	17 (89%)
Non-Patent (Azoospermia)	8 (47%)	4 (29%)	2 (11%)

noted in clinical obstructive azoospermia. The more distal regions have the poorest motility and the more proximal regions have the best motility. Young concluded that in an obstructed epididymis the more distal sperm are senescent, while the more proximal sperm have had time to mature despite having not traversed the epididymis.

Our clinical experience with specific tubule vasoepididymostomy supports Young's original thesis.

Surgical Technique

All vasoepididymostomies were performed with the "specific tubule" technique we have described, which involves an end-to-end anastomosis of the inner lumen of the vas to the epididymal tubule, mucosa-to-mucosa in a leakproof fashion.[39,42,43] Virtually all of the earlier literature on vasoepididymostomy involves a longitudinal cut through the epididymal tunic and into the epididymal tubule which resulted in a random cutting of the epididymal tubule in many of its convolutions, which gives the appearance of many tubules leaking spermatozoa. The vas is sutured to that outer epididymal tunic hoping that a fistula would form. Because of the high rate of technical failure with that methodology, reliable data on the fertility of spermatozoa from the epididymis in the past has been difficult to obtain.

With the "specific tubule" technique used in this series, the epididymis is transected proximally until the point is reached where many spermatozoa are found (Fig. 1). Fluid at every level is examined under a phase contrast microscope in the operating room for the presence of and quality of spermatozoa. The anastomosis of the vas to the epididymis is performed at the transition point from no spermatozoa to the point where there is an abundant amount of spermatozoa in the fluid coming from the epididymal tubule (Fig. 2).

The fact that when a technically successful anastomosis to anywhere along the corpus epididymis is achieved, almost 72% of the wives get pregnant, with a mean time to conception of six months, clarifies the issue that spermatozoa do not necessarily have to traverse the entire corpus or cauda epididymidis in the human to achieve fertilizing capacity.

The lower pregnancy rates in previous clinical series most probably relate to a number of factors. We performed a specific tubule anastomosis rather than create a fistula which could lead to lower "patency" rates, and even poorer spermatozoa motility in the cases that are "patent".[3,32] Newer microsurgical techniques have thus clearly improved the quality of spermatozoa in the ejaculate post-operatively.

It is fascinating that the numerical spermatozoa count had no impact on pregnancy rate, but spermatozoa motility did. This goes along with many clinical studies which demonstrate low spermatozoa counts in a high percentage of normal fertile males.[35,46,49,54]

If the oligospermia is caused by partial obstruction (or epididymal dilatation), poor motility would result, and then fertility may be compromised. But if a patient's oligospermia is simply a reflection of his low testicular sperm production, fertility may not be poor.

In 1969, Marie Claire Orgebin-Crist[27] asked whether factors governing the maturation process of spermatozoa are intrinsic to the spermatozoa, or whether they reside in the epididymis. Epididymal ligation experiments have not always been clear in answering this question because they cause dilatation and epithelial disruption which negatively affects the motility of spermatozoa so retained.[13,14,15,29,53] Yet Young was able to draw a tentative conclusion in 1931 that indeed sperm maturation may be completely independent of epididymal transport. Others have made similar speculations regarding the corpus and cauda epididymidis.[5,33]

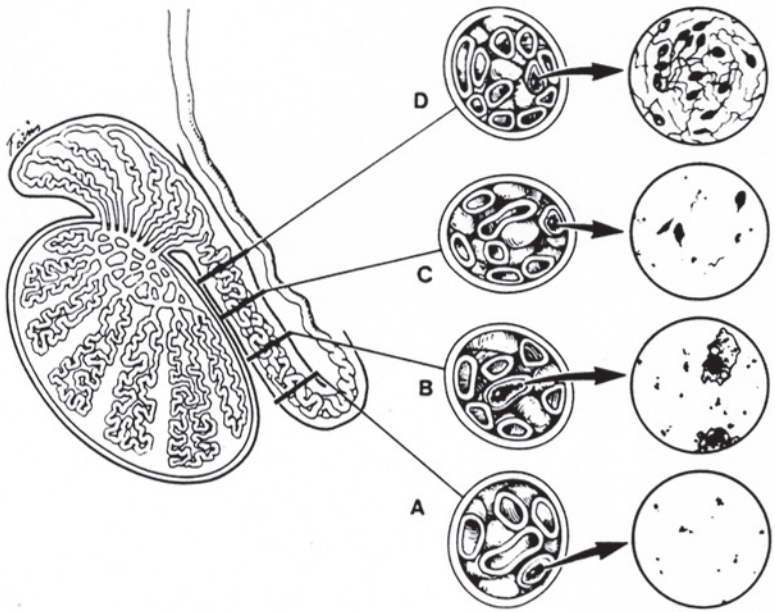

Fig.1. Serial sectioning of epididymis until the site of proximal-most obstruction is bypassed.

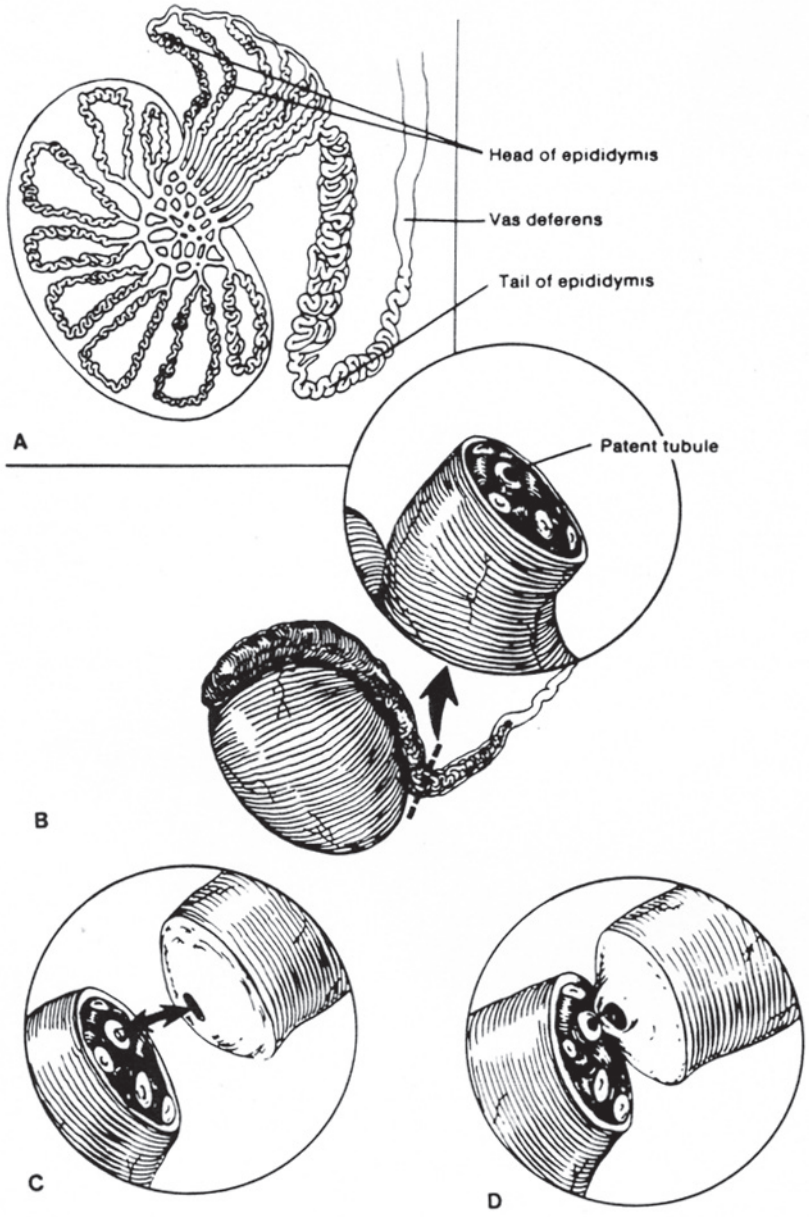

Fig. 2. "Specific tubule" anastomosis of vas lumen to the epididymis proximal to site of obstruction.

A vasoepididymostomy model such as ours, in which spermatozoa cannot traverse the full length of epididymis, would allow maturation to occur with time only in the vas deferens, and help clarify this issue. The fact that spermatozoa which could not have travelled through any portion of the corpus or cauda epididymidis were capable of fertilization, indicates that a full journey through the epididymis is certainly not required for maturation of spermatozoa sufficient to allow pregnancy. The fact that pregnancy occurred in almost half of the patent cases to the caput indicates that transit beyond the head of the epididymis is not an absolute requirement for spermatozoa to attain fertilizing capacity.

It should be emphasized that none of these patients underwent any special treatments such as in vitro fertilization or GIFT, and these pregnancies all occurred simply with natural intercourse. In the next several years we may find out whether with in vitro techniques more than 43% of these patients with spermatozoa from the caput epididymidis will or will not be able to accomplish fertilization.

Recent clinical cases have demonstrated that it is even possible in some circumstances for spermatozoa which have never traversed any length of epididymis to fertilize the human egg. In two cases reported of vasa efferentia to vas deferens anastomosis, the post-opertive ejaculate contained normally motile sperm, and the wives became pregnant.[44] In addition, pregnancy from aspiration of epididymal spermatozoa combined with in vitro fertilization and "ZIFT" in cases of unrepairable obstruction gives further evidence that transit through the epididymis is not a mandatory requirement for fertilization.[45,48] Finally, newer studies of epididymal sperm transport in the human indicate that the human epididymis is not a storage area, and indeed spermatozoa transit the entire human epididymis very quickly, in a mere two days; not eleven days as was previously thought.[20] Thus it is possible that in the human, the epididymis may not be as essential to spermatozoa development and fertility as it appears to be in most animals.

III. PREGNANCY WITH SPERM ASPIRATION FROM THE PROXIMAL HEAD OF THE EPIDIDYMIS: A NEW TREATMENT FOR CONGENITAL ABSENCE OF THE VAS DEFERENS

It has long been assumed that sperm must pass through a certain length of epididymis to mature, gain progressive motility, and become capable of fertilization. In every animal thus far studied, sperm from the non-obstructed proximal head of the epididymis exhibit only weak, circular swimming motions, and are incapable of progressive motility or fertilization of the egg. It is thought that only when sperm have traversed through most of the corpus epididymis that they mature sufficiently to become progressively motile, and are able to fertilize.[27] But our observations suggest that their journey through the epididymis may not be an absolute requirement and that sperm may only require a period of time to mature after leaving the testicle.

Congenital absence of the vas deferens accounts for 11% to 50% of cases of obstructive

azoospermia, and heretofore has been considered basically untreatable.[11] This is a large and frustrating group of patients who have been shown on countless testicle biopsies to have normal spermatogenesis, and are theoretically making sperm quite capable of fertilizing an egg. Yet treatment up until the present time has been very dismal.[51]

Dr. Ricardo Asch and his team, along with our team have collaborated equally to develop a treatment protocol involving microsurgical aspiration of sperm from the proximal region of the epididymis, combined with in vitro fertilization (IVF) and zygote intrafallopian transfer (ZIFT), which now offers very good results in this previously frustrating group of couples.[35,45]

We now have a method for microsurgical sperm aspiration from the proximal-most region of the head of the epididymis, combined with IVF, with the first documentation of fertilization and pregnancy utilizing this approach for the treatment of congenital absence of the vas deferens.

Induction of Follicular Development and Oocyte Retrieval

The female partners of men with azoospermia caused by congenital absence of the vas underwent induction of multiple follicular development with the following protocol: Leuprolide acetate (Lupron, TAP Pharmaceuticals, North Chicago, IL) 1 mg subcutaneously daily (0800 h) from day 1 of the menstrual cycle until the day of follicular aspiration. Patients received human follicle stimulating hormone (FSH) (Metrodin, Serono Laboratories, Inc., Randolph, MA) and human menopausal gonadotropins (hMG) (Pergonal, Serono) 150 I.U. intramuscularly (IM) daily (4:00 pm) from day 2 of the menstrual cycle until days 9 and 8 (patients 1 and 2), respectively. Human chorionic gonadotropin (Profasi, Serono, randolph, MA) 10,000 I.U. was administered IM (9:00 pm) on days 9 and 10, respectively.

Thirty-six hours after hCG administration, the patients underwent follicular aspiration in the operating room under intravenous sedation with titrating doses of 0.1 to 0.25 mg of Fentanyl (Sublimaze, Janssen Pharmaceutical, Inc., Piscataway, NJ) and 5 to 7 mg of midazolam HC1 (versed, Roche Laboratories, Division of Hoffmann-La Roche, Nutley, NJ).

Follicular aspiration was performed using a transvaginal probe (GE H4222 TV) adapted to an ultrasound system (GE RT3,000, General Electric Company, Milwaukee, WI) with a needle set for ovum aspiration and follicle flushing (Labotect, Bovenden-Gotingen, FRG (#4060-2, length 300 mm, 1.4 mm outside diameter, 1.1 mm inside diameter) connected to a Craft Suction Unit (Rocket USA, Branford, CT) (#33-100) at a maximum vacuum pressure of 120 mm Hg.

Each case of follicular aspiration was performed without complications in less than 30 minutes and patients were discharged two hours after the outpatient procedure. The follicu-

lar fluids and follicular washings (with TALP-HEPES medium) were given immediately to the embryology laboratory adjacent to the operating room.

Epididymal Sperm Aspiration

At the same time, the husband undergoes scrotal exploration with the intention of aspirating sufficient numbers of motile spermatozoa to utilize for IVF of the aspirated eggs, with subsequent transfer into the wife's fallopian tube.

The surgical technique (Fig. 3) in the male was as follows: scrotal contents were extruded through a small incision, the tunica vaginalis was opened, and the epididymis was

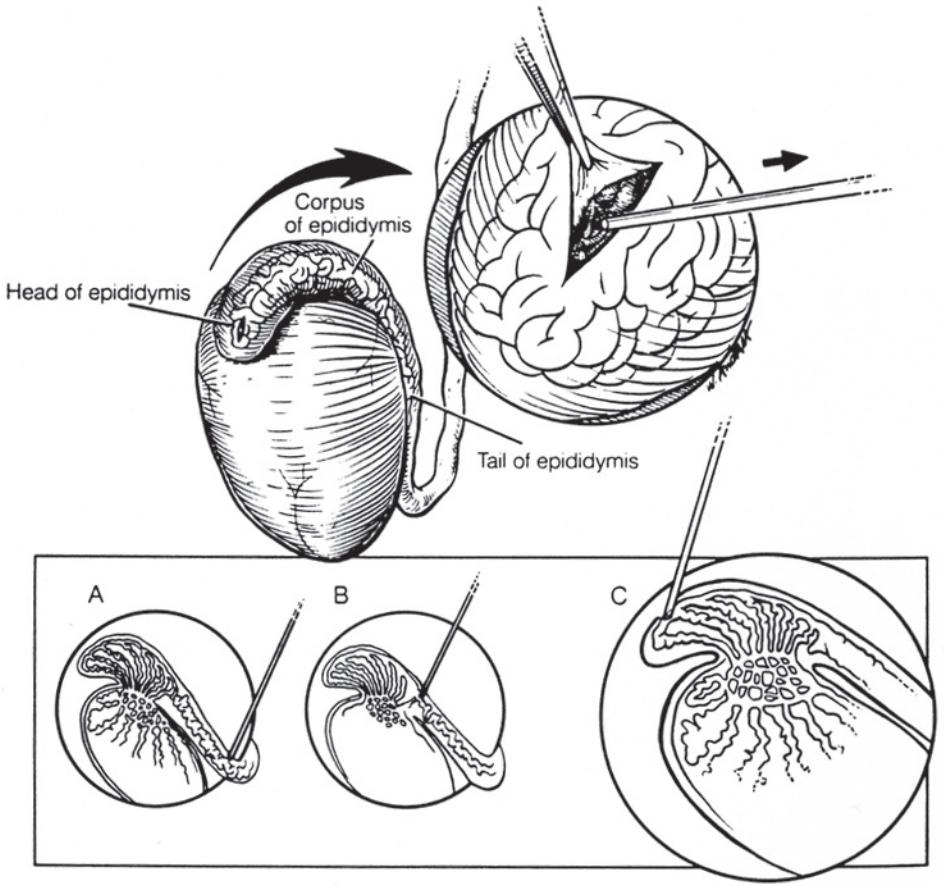

Fig. 3. Technique for epididymal sperm aspiration which begins in the distal corpus region of the epididymis, and moves proximally until motile sperm are recovered. In most cases, motility is observed only in the most proximal region of the epididymis.

exposed. Under 10-40X magnification with an operating microscope, a tiny incision was made with microscissors into the epididymal tunic to expose the tubules in the distal-most portion of the congenitally blind ending epididymis. Sperm were aspirated with a #22 medicut on a tuberculin syringe directly from the opening in the epididymal tubule. Great care was taken not to contaminate the specimen with blood, and careful hemostasis was achieved with microbipolar forceps. The epididymal fluid was immediately diluted in hepes buffered media, and a tiny portion examined for motility and quality of progression. If there was no motility or poor motility, another aspiration was made one-half centimeter more proximally. We thus obtained sperm from successively more and more proximal regions until progressive motility was found. In all cases, motile sperm were not obtained until we reached the proximal-most portion of the caput epididymis or vasa efferentia (Fig. 4).

Two days after insemination embryos are transferred to the fallopian tubes of each patient, via minilaparotomy using a technique similar to the one for gamete intrafallopian transfer (GIFT), via a Tomcat catheter (Monoject, St. Louis, MO) 2 1/2 cm inside the fimbrial ostium. The entire surgical procedure lasts approximately 30 minutes and the patients

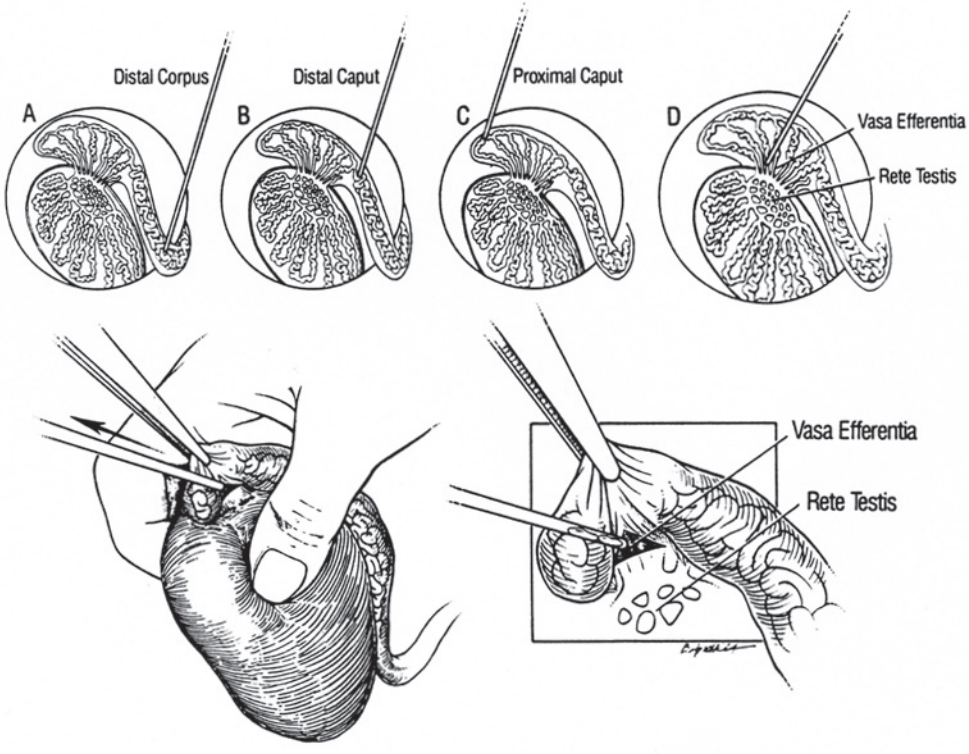

Fig. 4. Most motile sperm is found most proximally, usually in the vasa efferentia or rete testes fluid.

are discharged the next day and undergo an uneventful post-operative recovery. Patients receive progesterone in oil, 25 mg IM/day one day after the day of embryo transfer.

RESULTS

At present, of 32 cases, there have been ten pregnancies, two miscarriages, and eight ongoing or delivered live babies (25%).

Pregnancies which have occurred readily after vasoepididymostomy to the caput epididymis (and even in some cases to the vasa efferentia) suggest that immature sperm which have not had a chance to transit the epididymis might mature on their own during storage in the vas deferens.[44] If this theory were true, it might explain why we have been able to achieve success by aspirating more proximally, not being limited (because of theoretical considerations) to distal regions of the epididymis where the sperm are generally senescent and non-motile in the obstructed state.

Other factors in the success of this techique which may be equally important are: (1) Obtaining large numbers of oocytes in order to increase the odds for fertilization, (2) Incubation of sperm outside of the milieu of the obstructed epididymis, and (3) Transfer of the embryos into the fallopian tube (ZIFT) rather than into the uterus.

Although these results will have to be considered preliminary until greater numbers are obtained, for the moment it is safe to conclude: (1) Sperm from the proximal-most caput epididymis are capable of fertilization of the human egg in vitro, (2) Passage of time after emergence from the testicle may be adequate for sperm maturation without the absolute need for transit through the rest of the epididymis and (3) We now have an approach for achieving pregnancy in couples with a heretofore dismal condition, congenital absence of the vas deferens.

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