The Seoul Journal of Medicine
Vol. 27, No. 1:1-18, March 1986

Experience with 3,520 Infertile Male Patients and A Clinical Perspective

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= Abstract =The author's experience with a total of 3,520 infertile male patients during the period from 1955 to 1984 were reviewed based on the pathophysiology, etiology, evaluation and management. These infertile males corresponded to 4.2% of total male outpatients of the Department. Duration of barren marital life was 4.5 years. Completion of spermatogenesis from spermatogonium to spermatozoon requires 74±5 days. Causes of male infertility were faulty sperm production in 33%, faulty sperm transportation in 35%, faulty semen composition in 7%, faulty ejaculation in 3%, and idiopathic cause which is an eponym for ignorance in 22%. Normal testicular size of Korean males is 19ml. A man with a testicular size of 10 ml or less should be suspected as suffering from faulty spermatogenesis. Normal spermiogramme of our series reveals that volume is 2.6 ml; counts, 120×10^6/ml; motility, 60%; viability, 64%; activity grade, 3; motility index, 180; and morphology, 80%. Medical treatment was attempted to 723 subfertile males using 12 different pharmacological compounds for average of 6 months (2 treatment courses). Semen parameters improved in 28% and pregnancy resulted in 14% after the pharmacotherapy. Surgical therapy was applied to 1,119 patients. In vasovasostomy group (699 patients), anatomical success rates were 90% and functional success rates, 51% by microsurgical anastomosis technique. In epididymovasostomy group (281 patients), patency rates were 37% and pregnancy rates, 20% by microsurgery. In varicocelectomy group, spermiogramme improved in 30% and pregnancy occurred in 20% of the patients who had the varicocelectomy. However, 33% of the patients with varicocele who did not have varicocelectomy could impregnate their wives. The author is quite confident that the urologist who is skilled in andrology can provide better and more rational care for these infertile males.

Key Words: ***Male infertility, Causative factors, Evaluation parameters, Spermatogenesis, Spermiogramme, Results of treatments***

INTRODUCTION

This report consists of pathophysiology, evaluation and management of the male infertility based on the author's experience of the last three decades as an Andrologist.

Recent evidences suggest that factors in the male may be responsible for a sizable fraction of the fertility problems that affect 10 to 15% of the married couples. That is, 30 to 50% of fertility disturbances are caused by factors affecting the male and 20 to 35% of the reproductive failures are attributable to factors affecting both members of the fertility unit. We have investigated a total of 3,520 infertile males who married for more than 1 year for the past 30 years from 1955 to 1984 at the Dept. of Urology, Seoul National University Hospital. These infertile male patients correspond to 3.4% of total out-patients and 4.3% of total male out-patients of the Department. Primary infertility was found in 82% of the total infertile males, and the secondary, 18%. Age of the infertile males ranged from 21 to 61 with the mean of 32, and that of their partners ranged from 20 to 49 with the

mean of 29. Duration of barren marital life ranged from 1 to 40 years with the mean of 4.5 years. However, the duration of the infertile marriage shortened recently to less than 3 years. Coital frequency of the infertile couples ranged from 1 to 7 per week with the mean of 2.6 per week. It is our schemes that from the practical viewpoint, a couple is considered infertile if they should engage in unprotected intercourse for at least 1 year prior to evaluation since the average length of time necessary to achieve conception for most couples at the age of maximal fertility (25 years old) is around 5 months. Twenty-five per cent of couples have achieved pregnancy after 1 month of unprotected intercourse, 63% by the end of 6 months, 75% by the end of 9 months, and 80% by the end of 12 months. An infertile couple must first be evaluated as separate basis, then their interaction as a functioning fertility unit must be assessed. Initial evaluation of the male should be undertaken early in the course of the evaluation of an infertile couple because it is simpler than that of the female and is noninvasive.

The patient should be patient and persevere in order to become a father. Actually, infertile patient may have to be seen for 3 months to 1 year before one can even be certain that a given treatment has provided any benefit because process of sperm production and delivery to semen takes about 3 months.

Some terms related to the fertility may be pertinently used in this report in such a way that a man with child is a father but not fertile. A man who has impregnated a woman within 3 months is fertile but not father. A man who has no children without try yet is fertility unknown but not infertile. A man who has no children, even though has tried for more than 1 year, is infertile but not sterile.

PATHOPHYSIOLOGY

Central control of testicular function (hypothalamic-pituitary-gonadal-axis): The hypothalamus is a physiologic bridge between the cerebral cortex and the hypophysis, and is the site of origin for neurohumoral releasing factors that control the release of gonadotropins from the pituitary gland (Fig. 1). It is well known that spermatogenesis and steroidogenesis are two important functions of the testis. Production of both testicular steroids and spermatozoa depends upon the secretion of gonadotropin by the anterior pituitary gland. Follicle stimulating hormone (FSH) is held to be responsible

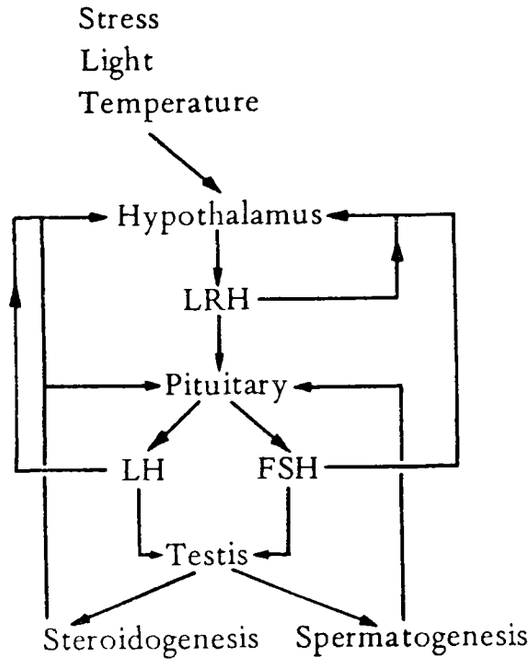

Fig. 1. Hypothalamic-gonadal axis.

for control of spermatogenesis and luteinizing hormone (LH) to be responsible for testosterone production. In turn, the secretion of FSH and LH by the pituitary gland depends upon production of a gonadotropin-releasing hormone (GnRH) from the hypothalamus. Chemical purification of the hormone named luteinizing hormone-releasing hormone (LHRH, LRF), and GnRH is capable of releasing both LH and FSH. LH(ICSH, interstitial cell stimulating hormone) increases the production of cyclic adenosine monophosphate by the Leydig cells which, in turn, stimulate testosterone production. FSH appears to bind to the Sertoli cell component of the seminiferous tubules and stimulates spermatogenesis. Normal levels of plasma FSH, LH, and testosterone ranged 4.0-25.0 mIU/ml, 4.0-18.0 mIU/ml, and 2.5-12.0 ng/ml, respectively.

Spermatogenesis: Spermatogenesis is dependent upon FSH, LH and testosterone, and is influenced and directed by Sertoli cells. The Sertoli cell tight junctional complexes subdivide the seminiferous epithelium into a basal testicular compartment (spermatogonia and spermatocyte) and aluminal testicular compartment (spermatocyte and spermatid) and constitute the so-called blood-testis barrier or blood-testis permeability barrier which is required for normal spermatogenesis. Sertoli cells regulate spermatogenesis. They are responsible for the movement of germ cells from the basal com-

partment to the luminal compartment and for the release of later spermatids. Germinal epithelium (seminiferous epithelium) consists of precursor of spermatozoa (spermatogonia, spermatocytes, and spermatids) and pyramid-shaped Sertoli cells. Spermatogenesis consists of an orderly progression from spermatogonium to spermatocyte, spermatid and spermatozoon. In human, the germ cell sequence includes: 1) spermatogonium, (the dark type A, the pale type A, and the type B), 2) the primary spermatocyte (the resting spermatocyte, the leptotene spermatocyte, the zygotene spermatocyte, and the pachytene spermatocyte), 3) the secondary spermatocyte, 4) spermatids (Sa, Sb_1, Sb_2, Sc, Sd_1 and Sd_2), and 5) spermatozoon. The associations or groupings of the germ cells are known as stages of the cycle of the seminiferous epithelium. In human, there are 6 stages or cell associations. Stages I to VI constitute 1 cycle of the seminiferous tubule. Duration of each cycle is 16 ± 1 days. Four cycles of the epithelium are required for spermatogonium to spermatozoon (Fig. 2). Heller and Clermont (1963) have established that in man it takes 4.6 cycles or 74 days (16 days$\times$4-6 cycles$=$74 days $\pm$5 days) for a mature sperm to develop from Ad spermatogonium to mature spermatozoon. However, complete spermatogenesis, practically, requires 4-6 cycles (16 days$\times$4-6 cycles$=$ 64-96 days). A testis contains 300-600 tiny seminiferous tubules, 0.2mm in diameter and 30cm in length, which occupy 90% of testicular volume. The combined length of both testicular tubules is about 800 meters, total numbers of daily sperm production come to 195 million and total numbers of daily sperm output come to 98-166 million. One spermatozoon out of 5,000 ejaculated spermatozoa reaches oviduct (Lee 1961 & 1964)

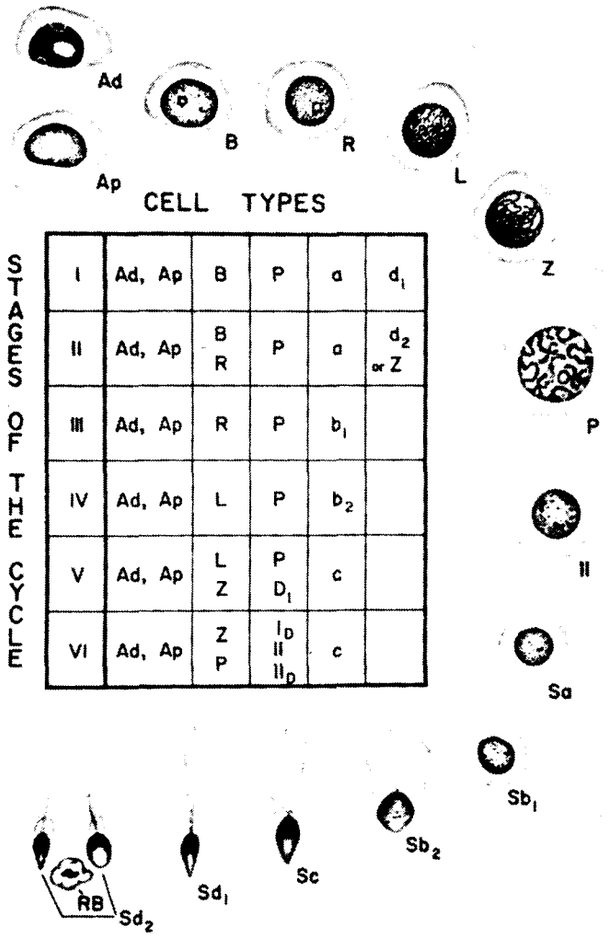

Fig. 2. The steps of spermatogenesis in man. Ad: dark Type A spermatogonium; Ap: pale Type A spermatogonium; B: Type B spermatogonium; R: resting or preleptotene primary spermatocyte; L: leptotene spermatocyte; Z: zygotene spermatocyte; Sa(a), Sb1(b1), Sb2(b2), Sc(c), Sd1(d1), Sd2(d2): spermatids; Rb: Residual body, D1: diakinesis; I_D and II_D: first and second maturation divisions of spermatocytes. (Modified from Clermont, Y. 1966).

Transport of spermatozoa: Mature human sperms are released from Sertoli cells into the lumen of the seminiferous tubule, move into the rete testis which is collection chamber for all the seminiferous tubules, and consists of 20-30 channels with 0.5 mm in diameter. The sperm leave the rete testis via the efferent ducts which consists of 12-20 channels, and pass into a 360-450cm long convoluted duct of ductus epididymides. About 40 ml of testicular fluid secreted into epididymis every day. Functions of the epididymis are sperm transportation, sperm maturation, sperm absorption, and sperm reservation. Sperm leaving the testis cannot fertilize ova since they are immature. During 12 days (3-21 days) transit from testis to cauda epididymis, sperm undergo changes in morphologic character, chemical composition, motility, fertility, metabolism, permeability, antigenicity, surface membrane, specific gravity, and response to various stressors. Twelve per cent of caput sperm have tail movement, but 34% of cauda sperm have progressive movement.

Sperm capacitation and fertilization: Sperm must reside in the female reproductive tract for several hours before they acquire the capacity to fertilize the ovum. This phenomenon has been called capacitation. Estrogen may serve to enhance capacitation, but progesterone may inhibit it. Many

changes occur in capacitated sperm including increased metabolism, sperm motility, membrane permeability, acrosome reaction, *etc.* Spermatozoon manifests three characteristic moving phenomena, such as chemotaxis (sperm moves from acid toward alkaline direction), rheotaxis (sperm moves contrary to the flow of fluid) and thigmotaxis (sperm moves around a foreign particle responding to the stimulus of contact).

ETIOLOGY

Classification: Etiology that may contribute to the reproductive disorders in the male have not been fully understood yet. However, etiological factors associated with male infertility may be classified in various ways. That is, based on the origin of causes, etiological factors are divided into (1) pretesticular causes including disorders of hypothala-

Table 1. Classification of etiology of male infertility

Categories of spermiogramme	Normo-spermia	Oligo-spermia	Astheno-spermia	Necro-spermia	Azoo-spermia	Total	(%)
Faulty spermatogenesis		248	112		706	1066	32.7
Testicular failure						450	13.8
Small testis		(55)			(285)	(340)	(10.4)
Klinefelter's syndrome					(96)	(96)	(2.9)
Orchitis					(14)	(14)	(0.4)
Varicocele		183	112		34	329	10.1
Hypogonadism					185	185	5.7
Cryptorchidism		10			74	84	2.6
Hydrocele					18	18	0.5
Faulty sperm transportation				1136	1136	34.8	
Vasectomy					761	761	23.3
Non-specific epididymitis					170	170	5.2
Gonococcal epididymitis					90	90	2.8
Tbc-epididymitis					71	71	2.2
Anomalies of vasa					33	33	1.0
Genital injuries					11	11	0.3
Faulty seminal composition	180			48		228	7.1
Pyospermias	90					90	2.8
Hemospermias	55					55	1.7
Asthenozoospermias				48		48	1.5
Antisperm antibody	25					35	1.1
Faulty ejaculation		86			22	108	3.3
Sexual problems		80				80	2.4
Retrograde ejaculation					22	22	0.7
Hypospadias		6				6	0.2
Idiopathic causes	284	427			11	722	22.1
Total	464	761	112	48	1875	3260	100.0
(%)	14.2	23.3	3.4	1.5	57.6	1000.0	
Poor records						260	
Total patients						3520	

mic-pituitary-gonadal-axis, (2) testicular causes including various factors affecting spermatogenesis, (3) post-testicular causes including factors of blocking the seminal tracts and (4) idiopathic causes. Based on the criteria of spermiogramme, (1) aspermia, (2) asthenozoospermia, (3) azoospermia, (4) necrozoospermia, (5) oligozoospermia, and (6) normospermia but infertile (Table 1). Based on the functional process of the genital organs, (1) faulty spermatogenesis including environmental causes, systemic causes, intratesticular causes, and iatrogenic causes, (2) faulty sperm transportation, (3) faulty seminal composition, (4) faulty sperm maturation, (5) faulty ejaculation, (6) faulty hormonal levels, and (7) idiopathic causes. The author prefers to use this last classification.

Causative factors of our seires: Causative factors of our clinical investigation revealed that faulty sperm transportation is 35%; faulty spermatogenesis, 33%; faulty semen composition, 7%; faulty ejaculation, 3%; and idiopathic causes, 22% (Kim and Lee 1980; Lee 1983 & 1984). When the prevalence of the causative factors of our series is compared with those of other reports, the obstructive disorders are found to be particularly higher in our series than others since we have had much more vasectomy reversals than any other clinics have done. On the contrary, frequency of varicocele of our series is apparently lower than the reports from United States (Geenberg 1978; Dubin and Amelar 1971) but is quite similar to those from Japan (Hori 1982) (Table 2).

Each causative factor is described as follows:

Testicular failure: Testicular failure may be found in patients with oligozoospermia who had abnormally small testes or an elevated serum FSH level. This category includes germinal cell aplasia (Sertoli cell only syndrome proved by biopsy), Klinefelter's syndrome, infantile small testes, orchitis (mumpus, tuberculous, nonspecific), testicular injury (surgery, secondary to radiotherapy, chemotherapy or torsion), and hypergonodotropic hypogonadism. Testicular failure represents an end organ disease and is usually irreversible.

Varicocele or pampinocele: Varicocele is a dilatation of the pampiniform plexus about the tes-

Table 2. Comparisons of causative factors of male infertility

Reporter (Year) No. Patients	Lee (1983) 3,260 (%)	Greenberg (1978) 425 (%)	Dubin (1971) 1,294 (%)	Hori (1982) 389 (%)
Obstruction	34.8	6.1	7.4	2.9
Vasectomy: 23.3				
Epididymitis: 10.2				
Vas agenesis: 1.0				
Genital injury: 0.3				
Testicular failures	13.8	9.4	14.0	1.6
Varicocele	10.1	37.4	39.0	4.8
Abnormal semen (%)	6.0	7.6	13.3	4.0
Pyospermia: 2.8				
Hemospermia: 1.7				
Asthenozoospermia: 1.5				
Hypogonadism	5.7	0.9	8.6	1.3
Sexual dysfunction	2.4	2.8	5.1	0.3
Cryptorchidism	2.6	6.1	4.4	1.3
Agglutination	1.1	3.1	0.8	
Retrograde ejaculation	0.7	1.2		
Hydrocele	0.5			
Hypospadias	0.2			
Idiopathic causes	22.1	25.4	5.4	83.8
Total	100.0	100.0	100.0	100.0

tis. The left side is most commonly affected (more than 80%). The varicocele has been implicated as a common cause of male infertility mainly on the basis of the following 3 observations: 1) the incidence of varicocele has been noted to be higher in the infertile males(39%) than that in the general male population of older than 18 years of age(20%), 2) in some males, varicocele is associated with abnormalities in semen quality and testicular histology, and 3) varicocelectomy has been noted to result in improvement in semen quality (50-90%), and pregnancy rate (20-50%). However, considerable controversy has been appeared in the literatures; 1) many patients with varicocele have normal semen quality and normal fertility, 2) varicocelectomy does not always improve semen quality, and 3) pregnancy may occur in patients whose semen quality did not improve after varicocelectomy. Varicocele has been related to infertility by 1) elevated scrotal temperature from stasis of venous blood, 2) retrograde flow of blood from the adrenal or renal vein which may contain toxic substances to spermatogenesis, 3) disturbances in the function of Leydig cells, and 4) vascular shunting with anoxia from decreased testicular blood flow (Shim and Lee 1981). There was no correlation between semen quality and varicocele size but the majority of evidence to date is favourable to a causal relationship between varicocele and male infertility. Varicocele is found in 30% (5-40%) of the subfertile males (Lee 1983).

Cryptorchidism or undescended testis: Semen quality is very poor in most patients with bilateral cryptorchidisms and is reduced in the great majority of patients with unilateral cryptorchidism. Even in unilateral cryptorchid patients, significant reduction in fertility potential could be found with or without prophylactic orchidopexy. Cryptorchid men who had undergone bilateral orchidopexy early at 18 to 30 months, 37-79% of them could be fertile, but who had surgery after puberty, 90% of them would be infertile. Unilateral cryptorchid men could be fertile in 80% without any surgical intervention (Lee 1964). Endocrine evaluation and karyotyping in those patients with bilateral undescended testes may show a higher incidence of abnormalities than in other men with infertility problems.

Endocrine disorders: Through complete and sophisticated diagnostic endocrinological evaluation, hypogonadotropic hypogonadism, eunuchoidism, Kallmann's syndrome, fertile eunuch could be found but no patient with the adrenogenital syndrome or clinically significant thyroid disease was found in our series.

Immunology: The presence of sperm agglutinating and sperm immobilizing antibodies and cytotoxic antibody may cause immunoinfertility in both males and females. An immunologic reaction should be suspected when agglutination is seen or when isolated decrease in sperm activity occur in the presence of normal sperm counts. Human semen contains at least 16 antibodies. Spermatozoa have a minimum of 7 antibodies, 4 of which are identical with those of seminal plasma. Although sperm antibodies are more common among infertile men(3%) than fertile men and in obstruction of the duct system(20%) (sperm agglutinating antibodies in 60% and sperm immobilizing antibodies in 30% after vasectomy), there is no conclusive evidence that these antibodies cause infertility. One of the main effects of antisperm antibodies seems to be the impairment of sperm penetration into cervical mucus. Recent report revealed that in the male partners, the highest and the most significant incidence was found in the serum and seminal plasma of the group with poor sperm motility (necrozoospermia and asthenozoospermia) than the control group with oligozoospermia and normospermia. Therefore, it is advisable to test antisperm antibodies in selected groups of infertile couples. A possible therapeutic approach is that administration of steroid with 7-day courses of methylprednisolone, 96mg per day from day 21 to 28 of the wife's menstrual cycle and repeated in alternate months for upto 6 months (conception rate: 31%). And betamethazone can be given in 7-day course, 2mg/day for 3 days, 1mg/day for 2 days and 0.5mg/day for 2 days on alternate weeks for upto 6 months (conception rate: 41%) (Shulman 1978). The other way of treating antisperm antibody method is sperm washing and insemination method (SWIM).

Thermoregulatory disturbances: The intrascrotal temperature is approximately 2-3°C cooler than that of the abdominal cavity for satisfactory spermatogenesis in the testis. For maintaining the low temperature of testis constantly some peculiar thermoregulatory mechanisms are functioning, 1) pre-cooling or pre-heating mechanims of the blood vessels distributed to testis, 2) contracting and relaxing mechanism of scrotum due to environmental temperature, and 3) insulating mechanism of scrotal skin. Consequently, frequent hot baths, prolonged exposure to sauna, hot working condition,

suspensory and other tight cloths may have deleterious effects on spermatogenesis. Febrile illness may cause poor sperm quality and motility for upto 3 months, since spermatozoa obtained in the ejaculate may be 74 days old.

Karyotype abnormalities: Karyotype abnormalities are associated with seminiferous tubular sclerosis. The classic XXY Klinefelter's syndrome, XYY syndrome, XX male syndrome are included in this category.

Genital infection: Prostatitis, urethritis, seminal vesiculitis have long been considered common causes of infertility. Patients with true pyospermia and symptomatic genitourinary infection may have temporary oligozoospermia and infertility. *Escherichia coli* exotoxins have been demonstrated to reduce sperm motility. However, the key factors in establishing infection as the source of infertility are to find symptomatic infection and to prove true pyospermia. *Chlamydia trachomatis* causes infertility in 39%, but *Torulopsis mycoplasma (Ureaplasma urealyticum),* cytomegalovirus or gram-positive commensals in urine and urine cultures are considered to be mild harmful effects on fertility.

Drugs and chemicals affecting spermatogenesis: It has been evident that the seminiferous tubules may be injured by a variety of drugs and chemicals. The germinal epithelium is a rapidly dividing tissue and is affected by agents that interfere with DNA synthesis or cell division. The drugs affecting reproductive functions and Leydig cell functions are chemotherapeutic agents such as chlorambucil, cyclophosphamide, nitrogen mustard, busulfan, procarbazine, sulfasalazine, nitrosoureas, colchicine, arsenics, aspirin, and chloramphenicol. Besides, alcohol, nicotine, marihuana, antiandrogens, antihypertensive drugs and cocaines are also hazardous for reproductive potential of males.

Effects of radiation: Although Leydig cell function and Sertoli cell function are relatively radioresistant, germinal epithelium is exquisitely sensitive to relatively low doses of radiation. Spermatogonia are more sensitive than spermatids. Spermatogonia are suppressed by 200 rad, but spermatids are suppressed by 400-600 rad. Oligozoospermia is induced by 50-80 rad and observed in patients 21 months after the exposure to 200-300 rad. Spermatogenesis impairment is generally permanent above 600 rad. And Leydig cell and testosterone level are decreased but LH levels are increased by 600 rad. Recovery of testicular histology requires 9-19 months after 100 rad, 30 months after 200-300 rad, and 5 years after 400-600 rad. Irradiation increases miscarriages, stillbirths, and other anomalies. Therefore, vasectomy is advisable for the man who has had radiation therapy, but does not want to have baby. Pregnancy should be allowed 18 months after the previous radiation, since anomalies will be prevented from the previous radiation therapy.

Nutrition: Nuritional disorders may result in a deficiency of nutrients necessary for spermatogenesis. Vitamin A deficiency may cause germinal cell degeneration. Vitamin B is a co-factor in various pituitary functions, and effects on sperm maturation. Vitamin C may prevent sperm agglutination, and spontaneous abortion. Vitamin E may prevent spontaneous abortion and enhance sperm motility.

Emotional stress: Job stress, feared parenthood, marital discord, and other psychogenic disturbances may not only impair sexual ability and performance but also may adversely affect spermatogenesis. In a classic study of prisons maintained on death roll for an extended period of time, marked progressive disturbances in sperm production were found.

Systemic diseases: Systemic diseases are somewhat related to the testicular function. Febrile illness has long been known to alter spermatogenesis. For example, oligozoospermia appears within 3 weeks after heat exposure and lasts approximately 50 days. Gonadal function among uremic men is another excellent example of how systemic diseases may alter reproductive function.

Sexual dysfunction: Significant sexual dysfunctions are also important etiological factors in the genesis of infertility since the patients with decreased libido, erectile impotence, poor intromission, poor coital timing, premature ejaculation, retarded ejaculation, and retrograde ejaculation could not impregnate their wives by natural intercourses.

Semen and biochemistry of seminal plasma: Too viscous unliquefied semen, too high density of more than 250×10^6/ml (hyperzoospermia), necrospermia, hematospermia, and pyospermia are not beneficial for fertility potential. Some changes in the biochemistry of seminal plasma may be possible causes of male infertility. Biochemical analysis of seminal plasma can give informations on 1) the secretory function of the accessory genital glands, 2) the ejaculatory process, 3) the integrity of the sperm membranes, 4) the secretion of endogenous and exogenous compounds into seminal plasma

and also the route of secretion, and 5) the effects of specific factors in the seminal plasma on functional properties of the spermatozoa.

Obstruction: Azoospermia was found in many patients because of previous elective vasectomy, bilateral congenital absence or atresia of the vas deferens and/or seminal vesicles, absence of vas deferens and/or epididymis and in the patients who had obstruction secondary to inflammatory diseases such as tuberculosis, gonorrhoeae, small pox and non-specific inflammations.

Age: Testosterone production decreases and hypospermatogenesis appears in aged males but there are reports of men in their eighties and nineties fathering children.

Idiopathic infertility: Idiopathic is an eponym for ignorance. By definition, these men had no demonstrable physical abnormality compatible with infertility nor did they have any of the other conditions related to subfertility but they did have mostly abnormal semen quality. However, we found that these men whose sperm parameters revealed normal but infertile with the coital partners whose fertility potentials demonstrated normal. The etiological, prognostic, or therapeutic significance of these patients is unclear. We included in the idiopathic group those men whose testicular biopsies demonstrated maturation arrest. Many theoretical causes have been suggested for this idiopathic subfertility, such as physical or emotional stress, infection, genetic abnormality, and exposure to substance that are antispermatogenic in the adult or even in utero.

EVALUATION

Through thorough evaluation of infertile males by history, physical examination, laboratory works and other specific surveys, the definite diagnosis is tried to be made but it cannot be always possible.

History: 1) certain past medical history including genitourinary tract disturbances, surgeries, hypospadias, cryptorchidism, endocrinopathy, sexual dysfunctions, 2) family history including renal, endocrine, cardiac, inherited diseases and other systemic disorders, 3) sexual history including libido, erection, ejaculation, orgasm, resolution, frequency of coitus, extramarital coitus, and sexual partner, and 4) social, enviromental and work history including exposure to radiation, toxic chemicals, extreme changes of temperatures, work stress, habitual smoking, alcohol intake, drug use, hot sauna, tight jocky-type underwear and dietary habit should be obtained in detail, and unassuming manner. Besides, partner's reproductive history and previous patient's fertility history are also carefully obtained.

Physical examination: 1) General assessment of body habitus including height, weight, comparative length of extremities, and distribution of body hair, screening neurologic examination with patient's reflexes, blood pressure, cardiac examinations, chest, gynecomastia, abdominal examinations and genital examination including size of penis should be precisely attempted. 2) Examination of scrotal contents should be thoroughly performed. Besides careful palpation of testis consistency, both vasa, and epididymis, testis size(volume) should be measured using an orchidometer. Normal testicular size of Korean males is 19ml (12-35ml) (Kim and Lee 1982). It has been generally believed that a man with a volume of 10ml or less should be suspected as suffering from faulty spermatogenesis. Therefore, further studies should be needed for the patients with such small testes. As the relationship of testis size and diagnosis of infertile males is shown in the Table 3, the prognosis may be irreversible and artificial insemination with donor or adoption should be recommended in azoospermic patients with elevated FSH and small testes. 3) Detection of varicocele is the most critical. In order to detect the varicocele and subclinical

Table 3. Relationship of testicular size, diagnosis and management of male infertility

Testis size (ml)	Diagnosis	Treatment
Impalpable	Anorchia, Eunuch	Exploration
	Cryptorchidism bilateral	Exploration Orchidopexy
1-3	Hypergonadotropic hypogonadism	Testosterone for virilization
1-4	Hypogonadotropic hypogonadism	FSH, LH for spermatogenesis Testosterone for virilization
8-10	Germinal aplasia	None
10-12	Germinal arrest	Medical therapy
10-15	Hypospermatogenesis	Medical therapy
15-25	Obstruction	Surgical therapy

varicocele, the patient first has to adapt room temperature (18-25°C) for 10 minutes. The patients now holds his penis. By inspection of scrotal vessels of fullness in the cord above the testicle, which can be alleviated by gently sqeezing the veins or by a filling pulse during Valsalva maneuver is diagnostic. Recently some new techniques such as Doppler flow measurement, contact scrotal thermography, radionuclide angiography, and retrograde venography are available to disclose the subclinical varicocele in which the reflux is present in the spermatic vein but no distention of the pampiniform plexus can be palpated. Small or grade I varicocele (10%) is mass of veins being less than 1cm in diameter and is detectable during Valsalva maneuver. Moderate or grade II varicocele(20%) is the bulk of veins being estimated to have a thickness of 1 to 2cm and is palpable during Valsalva maneuver. Large or grade III varicocele(70%) is the bulk of venous channels being geater than 2cm in diameter and is visible during Valsalva maneuver (Choi *et al.* 1983). 4) Finally, rectal palpation of seminal vesicles and prostate is also important.

Laboratory examinations: In addition to routine laboratory surveys including complete blood count, liver function tests, laboratory evaluation begins with urinalysis to disclose systemic desease or genitourinary infection. Biochemistry of seminal plasma should be analyzed to evaluate secretory functions of the accessory sexual glands: For prostate: acid phosphatase, citric acid, zinc, magnesium, inositol, *etc.* For seminal vesicles: fructose, prostaglandins, amylo-6-glucosidase, basic proteins, *etc.* For epididymis: glycerylphosphorylcholine (GPC), carnitine, acetyl-carnitine, *etc* (Lee 1983; Park and Lee 1983). Plasma hormone assays (FSH, LH, testosterone, and prolactin) are also necessary to rule out hypogonadisms. Immunological study for antisperm antibodies in serum and seminal plasma is attempted by means of gelatin agglutination test (GAT, Kibrick macroscopic agglutination test), tray agglutination test (TAT, Friberg microscopic agglutination test), sperm immobilization test (SIT, Isojima test), and enzyme-linked immunosorbent assay (ELISA) (Choi and Lee 1984). Karyotype evaluation is sometimes necessary to exclude possible cause.

Semen analyses: Some terminology used for the semen analysis and spermiogramme may be shown in Table 4. Semen is composed of spermatozoa and seminal plasma. Analysis of semen can provide the testicular output of spermatozoa, the functional properties of the spermatozoa, and the secretory function of the accessory genital glands. Semen is composed of secretions from Cowper's (5-10%), from prostate (13-32%), and from seminal vesicles (46-80%), and of spermatozoa (5-10%). The ejaculate is actually composed of three sequential secretions from Cowper's gland and prostate, from the testes, epididymides and vasa, and from the seminal vesicles. Spermatozoa and ampullary fluid appear in this first portion of the ejaculate, contributing about 10% of the ejaculated volume. In approximately 90% of men, the

Table 4. International nomenclature of human semen parameters

Terminology		Korean(國文)	Spermiogramme
America	Arctic, Europe		
Normospermia	Normospermia	正常精液	Volume of ejaculate within normal range
Hyperspermia	Hyperspermia	多精液症	Ejaculate volume large than 6ml
Hypospermia	Hypospermia	少精液症	Ejaculate volume less than 1ml
Polyspermia	Polyzoospermia	多精子症	Counts over 250×10^6/ml
Oligospermia	Oligozoospermia	減精子症, 減少精子症	Counts less than 20×10^6/ml
Asthenospermia	Asthenozoospermia	弱精子症, 無力精子症	Spermatozoa with decreased motility of less than 30%
Necrospermia	Necrozoospermia	死精子症, 死滅精子症	All spermatozoa are dead judged by supravital staining
Teratospermia	Teratozoospermia	異精子症, 奇形精子症	More than 40% of morphologically abnormal spermatozoa
Azoospermia	Azoospermia	無精子症	No spermatozoa are found in semen
Aspermia	Aspermia	無精液症	No semen ejaculated

greatest concentration of high quality sperm is contained in the first one-third of the ejaculate.

Collection of semen: The semen specimen should be collected by masturbation or coitus interruptus in a dry, clean wide-mouth and non-metalic jar after 3 days of abstinence period (acceptable limits: 1-7 days). Keep the semen specimen at room temperature for 30 minutes. Semen analyses should be repeated 3 tests at 1-3 weeks intervals (Eliasson 1981).

Colour and odor: The semen is normally grayish-white and opalescent. A yellow, brown or red discoloration of the semen may indicate genital infection. Smell is similar to chestnut flower odor.

Coagulation, liquefaction and viscosity: Although semen is in a liquid state upon ejaculation, it immediately becomes a coagulum. Twenty minutes later, the semen liquefies and thereafter remains in viscous state. Viscosity refers to the fluid state of the semen after the normal processes of coagulation and liquefaction have taken place. Normally, after allowing the semen to stand 20-30 minutes, it will assume a fully liquefied state. A normal viscosity will be expelled in discrete and small droplets (Kim and Lee 1975).

pH: The pH of the seminal fluids is determined using hydroion paper. Normal pH is 7.5 (7.0-7.8). If the pH is higher 7.8, it may be associated with infections of the accessory genital organs.

Volume: Semen volume ranges from 1 to 6ml with the mean of 3ml. Semen analyses contained 12% of abnormal volume. That is, low volume (hypospermia), less than 1ml, may be caused by retrograde ejaculation, hypoandrogenecity, dysfunction of accessory sexual glands, or improper collection of semen. High volume (hyperspermia), more than 6ml, occupying 10% of semen analyses, resulted in low concentration of sperm. Therefore, split ejaculation may be advisable for the patients with high volume of seminal fluids.

Density: Sperm concentration can be determined by using either the hemocytometer or an electronic Coulter Counter. Two-3 separate testings are usually necessary. Average normal is 60×10^6 or more per ml or a total of $150\text{-}200 \times 10^6$ or more per ejaculate. Minimal normal standard is 20×20^6/ml with a total count of at least 100×10^6/ejaculate. Polyzoospermia, 250×10^6/ml, can result in mechanical interference with sperm motility ad migration. It occupies 1-2% of fertile population and causes spontaneous abortion more frequently (40%) than overall incidence of the spontaneous abortion (17%).

Motility: Quantitative motility (wet-drop method) is determined by counting both motile and immotile spermatozoa in at least 10 separate and randomly selected fields. At least 100 spermatozoa must be counted. More than 40% is normal value. Qualitative motility or activity grade is determined subjectively by grading the forward progression made by the largest numbers of the spermatozoa. The activity of the spermatozoa is grade as 0-4 according to the characteristics of the movements. Grade 0: no motion. Grade 1: sperm moving in place. Grade 2: sperm moving with slow forward progression. Grade 3: sperm moving in a straight line with moderate speed. Grade 4: sperm moving in a straight line with high speed. Grade 3 is normal. Motility score or motility index is accomplished by multiplying numerical value or motility by activity grade. Normal is over 150. Fertility index is done by multiplying numerical value of total counts by motility. Over 185 is highly fertile; 80-185, relatively fertile; 1-80, subfertile; and 0, infertile.

Sperm viability: Viability of sperm is assessed by supravital staining or live-dead staining technique by use of eosin-nigrosin since immotile sperm does not mean dead sperm. The cell membranes of live sperm are impervious to eosin, whereas those that are dead easily take up the eosin stain, producing a red cytoplasm that contrasts with the blackish-violet background of nigrosin. Live sperm

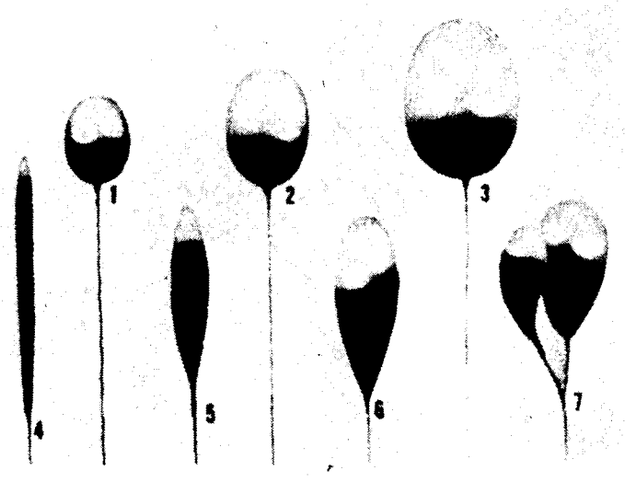

Fig. 3. Diagramatic representation of certain deviations in shape and size of human spermatozoa.
1: small form; 2: normal size and shape; 3: magaloform; 4:acute tapering form; 5: moderate taper; 6: tendency to taper; and 7: bicephalic. (From MacLeod, J. 1965).

are over 60%.

Morphology: For the analysis of sperm morphology, Papanicolau's staining technique is very useful and convenient for differentiation of the immature germ cells from white blood cells. More than 300 sperms should be examined. Over 60 different sperm forms have been identified, but for practical purposes 7 major types may be characterized according to the shape or size of the sperm head. They include: oval(normal), 60-73%; large(macrocytic), 5-9%; small(microcytic), 8.8-10%; tapering, 6-10%; duplicate (bicephalic), 1-2%; immature, 0.3-4% (do not confuse with WBC); and amorphous, 8.3-15%. In a normal analysis, greater than 60% of sperms will be oval in shape (Fig. 3).

Lower limit of normal density: Recent studies have emphasized that spermatozoal motility and morphology are the most crucial factor in determining its fertility capacity and sperm density is a limiting factor only below 10×10^6/ml. However, it would seem wise to set the division between fertility and subfertility at sperm counts of 20×10^6/ml or more since the pregnancy rates became distinctly higher in the sperm counts of 20×10^6/ml. Consequently, fertility capacity should be high when the sperm counts are more than 40×10^6/ml, and should be moderate when the sperm counts are less than $20\text{-}39 \times 10^6$/ml, and should be low when the sperm counts are less than 20×10^6/ml. (Table 5). Spermiogramme of our infertile males is shown in the Table 6. Normal spermiogramme suggested by WHO is as follows: volume, 1.5-6.0ml; density, more than 20×10^6/ml; motility, more than 40%; viability, more than 60%; morphology; more than 50% normal forms; and WBC, less than 1×10^6/ml. Normal data of our spermiogramme are compared with that of some other reports (Park and Lee 1977; Farris 1949; MacLeod 1952) (Table 7).

Testicular biopsy: Testicular biopsy is mandatory in azoospermic men with normal sized testes to distinguish between ductal obstruction and spermatogenic failure as the cause of azoospermia. In men with poor semen quality of azoospermia and small testes, the biopsy often assists in making a definitive diagnosis, which helps the physician in giving the patient a prognosis and avoiding unnecessary treatment in irredeemable situations. Bilateral biopsy is indicated if there is any suggestion from the history and physical examination that the patient has different lesions of each side, such as ductal obstruction, and primary testicular failure. It has been demonstrated that a significant temporary decrease in sperm count in 22-42 days following bilateral testicular biopsy in 45% of the subjects, due to secondary to antibody formation but no antibodies up to 14 days after testicular biopsy developed. Patients with azoospermia and high serum FSH levels are not biopsied since the spermatogonial population is usually irreversibly depleted. Patients with azoospermia and normal FSH levels are assumed to have obstruction and a biopsy is performed only if reconstructive surgery is planned. If the patient with severe oligozoospermia is found to have normal sized testes and normal FSH levels, a biopsy is performed since the finding of a relatively normal seminiferous epithelium may indicate the presence of partial epididymal obstruction. We are

Table 5. Fertility capacity and spermiogramme

Parameters \ Grades	High	Moderate	Low
Counts (10^6/ml)	40	20-39	20
Motility(%)	60	40-59	40
Morphology(%)	80	60-79	60

Table 6. Spermiogram of infertile males of our series

Parameters \ Categories	Normo-spermia	Oligo-spermia	Azoo-spermia	Astheno-spermia	Aspermia	Total
Semen examined (No. patients)	464	761	1853	160	22	3260
Volume (ml)	2.7	2.3	2.5	2.4	0	
Density (10^6/ml)	95.5	19.9	0	68.6	0	
Motility (%)	66	30	0	9	0	
Morphology (%)	78	74	0	76	0	
% of frequency	14.2	23.3	56.8	4.9	0.8	100.0

Table 7. Normal data of spermiogramme

Reporter (Year) No. patients	Lee (1977) 30	Farris (1949) 49	MacLeod (1952) 1,000
Liquefaction (minutes)	28(10-35)		
pH	7.4(6.8-8.0)		
Volume (ml)	2.7(1.5-5.0)	4.3	3.4
Count (10^6/ml)	120(40-290)	145	107
Count (10^6/ejaculate)	305(90-625)	555	350
Active cell (10^6/ml)	77(27-183)	64	
Active cell (10^6/ejaculate)	208(73-494)	246	
Motility(%), hanging drop	60(40-76)	46	58
Supravital-motile	64(45-75)		
-nonmotile	18(10-28)		
-dead	18(7-40)		
Morphology(%)-oval	80(72-98)	90	80
Velocity (sec./50 micron)	1.8(1.4-2.3)	1.2	
Endurance test-2 hours(%)	63(38-80)		
-8 hours(%)	38(20-55)		
-24 hours(no./HPF)	12(0-50)	76	
Activity grade	3(2-4)		
Motility index or score	180(80-304)		3
Fertility index	183(36-475)		186

now performing testicular biopsy by means of percutaneous needle biopsy technique using new Tru-Cut needle and analyzing histology quantitatively by counting numbers of mature spermatids per seminiferous tubule since significant correlation was demonstrated between sperm density and mature spermatid counts. Findings of testicular biopsy are classified as follows: normal testis with obstruction (23%), spermatogenic maturational arrest (16%), germinal cell aplasia (18%), peritubular fibrosis (17%), and premature sloughing of immature cells (26%) (Lee *et al.* 1985).

X-ray examination: Vasography, epididymography, seminal vesiculography are necessary to identify the site of obstruction in azoospermic men with normal spermatogenesis. However, it should be done with careful precaution since it is associated with a risk of irreversible damage on these accessory sex glands.

Other tests: Sperm-cervical mucus penetration assay (post-coital test) *in vivo* or *vitro* and sperm-oocyte interaction test (zona pellucida-free hamster eggs penetration test) are recently used for some infertile couples.

Diagnostic process of the infertile males particularly azoospermic patients is shown in the Fig. 4.

MANAGEMENT

Management of the infertile males is composed of general treatment, medical treatment, surgical treatment, and therapeutic or artificial insemination. A total of 1,842 patients (52%) out of the entire infertile males (3,520 patients) were submitted to various treatments and were followed for more than 1 year.

Medical treatment:

Medical treatment was attempted to the 723 infertile males. They were divided into a normogonadotropic oligozoospermia group consisting of 503 patients with sperm density of less than 20×10^6/ml, an asthenozoospermia group consisting of 48 patients with sperm motility of less than 30% and a hypogonadism group including 172 patients with 150 hypogonadotropic hypogonadisms and 22 normogonadotropic hypogonadisms (Table 8). Duration of medical treatments ranged from 1 course to 8 courses with the mean of 2 courses. One course consists of 3 months of continued administration of drugs. Responsiveness to the treatment are evaluated in the following arbitrary manner. That is, improvement represents sperm counts and motility improved more than 20% of the pre-treatment

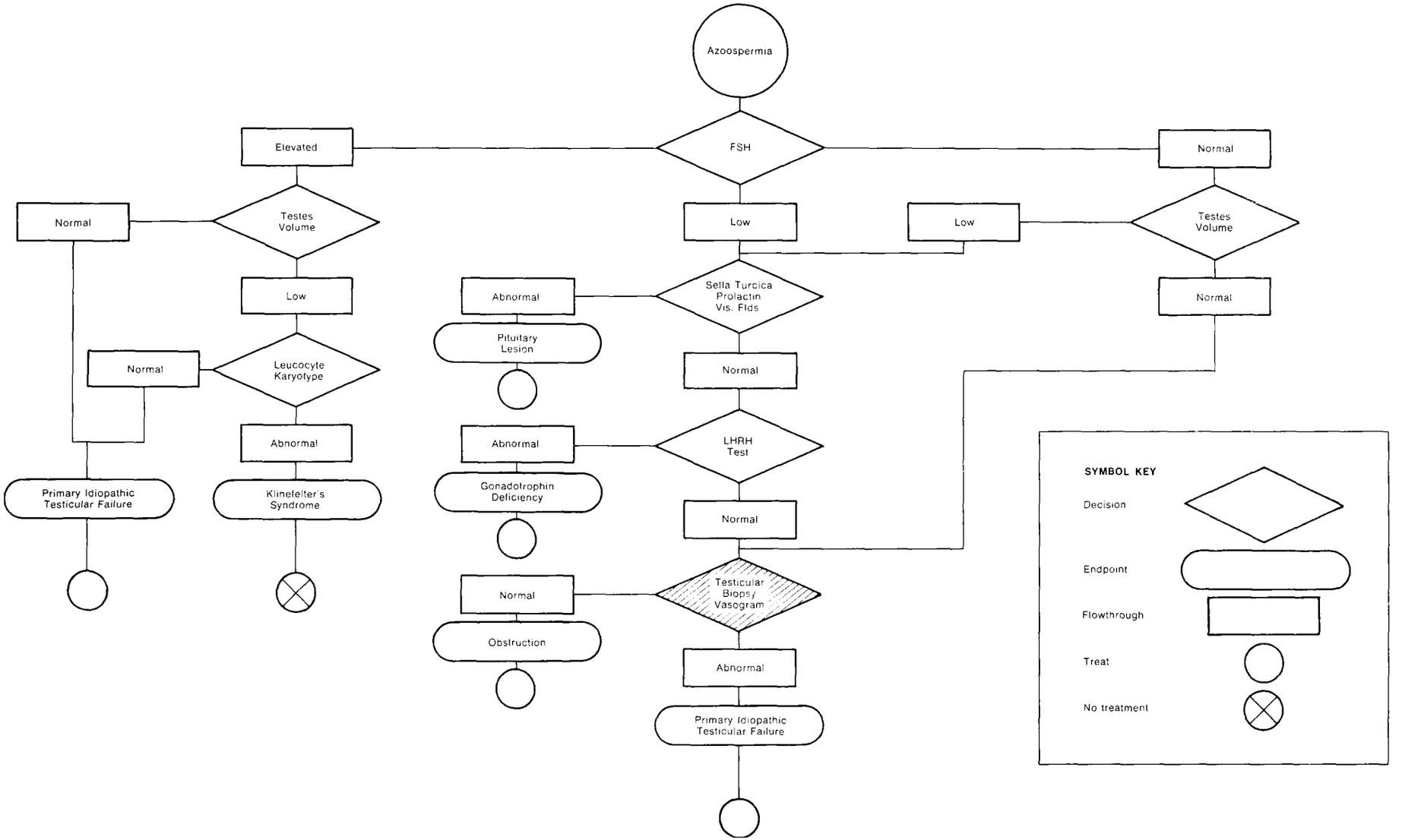

Fig. 4. Diagnosis of the infertility (azoospermia) in the male. (From WHO flow chart for the diagnosis of infertility in the male).

Table 8. Summary of results of medical treatment by groups

Groups	No. patients	Improved semen		Pregnancy	
		No. patients	%	No. patients	%
Normogonadotropic oligozoospermia	503	172	34.2	98	19.5
Hypogonadotropic hypogonadism	150	9	6.0	1	0.7
Normogonadotropic hypogonadism	22	10	45.5	2	9.1
Asthenozoospermia	48	8	16.7	2	4.2
Total	723	199	27.5	103	14.2

Table 9. Summary of medical treatment for infertile males

Drugs used	No. patients	Improved semen		Pregnancy	
		No. patients	%	No. patients	%
Amino acids	77	20	26	11	14
L-Arginine	40	10	25	5	13
AICAMIN	29	8	28	5	17
A.T.P.	8	2	25	1	13
Vitamins	50	14	28	6	12
Ginsen (panabolide)	17	3	18	1	7
Antiestrogen	54	14	26	3	6
Clomiphene	39	10	26	2	5
Tamoxifen	15	4	27	1	7
Kallikrein	63	18	29	9	10
Bromocriptine	10	3	30	1	14
Triiodothyronine	62	10	16	6	10
Mesterolone	55	17	31	10	18
Testosterone rebound	14	4	29	2	14
H C G	57	17	30	11	19
H M G	40	12	30	6	15
H C G + Amino acids	85	26	31	15	18
H C G + Vitamins	95	28	29	14	15
H C G + H M G	43	13	30	8	19
Total (average)	723	199	28	103	14

baseline values. Pregnancy represents only the first pregnancy after the treatment in each pregnant woman (Lee and Kim 1980). Semen quality improved in 28% ranging from 16% (by triiodothyronine) to 31% (by mesterolone and puberogen(HCG) plus amino acids). Pregnancy induced in 14% ranging from 5% (by clomiphene) to 19% (by puberogen(HCG) and peamex(HMG) combinations) (Lee and Choi 1985) (Table 9). In normogonadotropic oligozoospermia group, semen quality improved in 34% and pregnancy occurred in 20% of the patients. In asthenozoospermia group, semen quality improved in 17% and pregnancy occurred in 4% of the patients. Sperm could be found in 6% and pregnancy resulted in 1% of the hypogonadotropic hypogonadism and sperm in 45%, and pregnancy in 9% in normogonadotropic hypogonadism with small testes after the long-term

Table 10. Comparisons of results of medical therapy on infertile males

Reporters (Year)	Lee (1983)	Sherins* (1986)	Nishimura (1979)
Kinds of drugs used	12	8	2
No. patients treated	723	2,307	48
Improvement			
No. patients	199	785	16
%	28	34	36
Pregnancy			
No. patients	103	416	3
%	14	18	7

* Summary of 33 reports

combined hormonal treatment of HCG and HMG (Rou and Lee 1983) (Table 8). Similar results were obtained by Sherin's summary report (1986) that semen improved in 34 % and pregnancy resulted in 18 % of the 2,307 patients who were treated with 8 different drugs. Nishimura (1979) reported that semen improved in 36% and pregnancy occurred in 7% of the patients after medical treatments (Table 10).

Surgical treatment:

Surgical treatment was applied to the 980 infertile males utilizing various surgical procedures. They were divided into 699 vasovasostomy group, 281 epididymovasostomy group, 57 varicocelectomy group, and 82 andrologic operation group (Table 11).

Vasovasostomy group: In the 699 patients who were operated for reversal of post-vasectomy azoospermias, 329 patients were operated by conventional or macrosurgical technique and the remaining 370 patients were done by microsurgical technique. Duration of obstruction ranged from 1 day to 16 years with the mean of 4.2 years. Reasons for requesting the reversal operation were remarriage in 289 patients, death of children in 250 patients, change of attitute in 119 patients, and psychological problems after vasectomy in 31 patients. A total of 624 patients out of the 699 were followed for more than 1 year. Better results were obtained in shorter duration of obstruction, bilateral straight vas-to-straight vas anastomosis, bilateral leakages of spermatic fluids with sperm from proximal vas end. Results of end-to-end anastomosis technique were similar to the side-to-side technique in macrosurgery and those of two-layer technique were also similar to full-thickness technique in microsurgery. Success rates were 84% for patency and 35% for pregnancy in the 300 macrosurgeries and 90% for patency and 51% for pregnancy in the 324 microsurgeries (Lee 1978, 1980, 1985a, 1985b & 1986).

Epididymovasostomy group: One-hundred and 69 patients out of the 281 patients with azoospermia due to inflammatory epididymal obstruction were operated under a surgical microscope and the remaining 112 patients were done by a conventional technique. A total of 255 out of the 281 were followed for more than 1 year. Suspected causes of the obstruction were nontuberculous epididymitis in 179 patients, tuberculous epididymitis in 91 pa-

Table 11. Surgical correction of obstructive azoospermias

Operations / Results	Vasovasostomy No. patients	%	Epididymovasostomy No. patients	%
Total operation (1964-1983)	699	—	281	—
Semen examined	624	100	255	100
Sperm appeared	544	87	88	35
Pregnancy occurred	270	43	44	17
Macrosurgery (1964-1978)	329	—	112	—
Semen examined	300	100	97	100
Sperm appeared	252	84	30	31
Pregnancy occurred	105	35	12	12
Microsurgery (1979-1983	370	—	169	—
Semen examined	324	100	158	100
Sperm appeared	292	90	58	37
Pregnancy occurred	165	51	31	20

tients, and injury of scrotal contents in 11 patients (33 cases of bilateral agenesis of vas deferens were excluded). Success rates were found to be better in patients with non-tuberculous epididymitis than tuberculous epididymitis. There were no significant differences among the anastomosis levels of epididymal window. Consequently, success rates were 31% for patency and 12% for pregnancy in the 97 macrosurgeries, and 37% for patency and 20% for pregnancy in the 158 microsurgeries (Lee 1978, 1985a & 1985c; Lee *et al.* 1980).

Varicocelectomy group: A total of 57 infertile patients with left-sided varicocele were investigated in our Department. After the varicocelectomy by high ligation of internal spermatic veins, spermiogram improved in 30% and pregnancy occurred in 20% of the 51 patients, but pregnancy resulted in 2 patients out of 6 patients with varicocele without varicocelectomy (33%) (Lee *et al.* 1984).

Andrologic operation group: Various operations were performed on 82 patients. Hydrocelectomy for 20 patients with hydrocele, urethroplasty for 5 hypospadias and for 7 patients with urethral injuries, orchidopexy for 17 patients with cryptorchidism, and exploration of scrotal contents for 33 patients with congenital vas agenesis. Results of these plastic surgeries were found to be fairly good.

Alloplastic spermatocele: Patients who are infertile because of congenital absence of the vasa or anejaculation after retroperitoneal operation have been a special problem. Attempts at construction of artificial spermatoceles with grafts of corrugated polytetrafluoroethylene are promising. The graft is sutured to a distal epididymal window and brought laterally into a dartos pouch. Sperm were obtained by aspiration of the spermatocele, and used for artificial insemination. But successful inseminations were very limited.

Artificial insemination with cryopreserved sperm: The use of artificial or therapeutic insemination of the husband's sperm is useful in cases of hypospadias, retrograde ejaculation, neurologic impotence, and refractory sexual dysfunction. Preservation of human sperm by cryogenic methods (frozen sperm bank) at −196°C liquid gases has been developed successfully and applied to reproductive biology. Some advantages include 1) availability of sperm for donor (heterologous) insemination, 2) accumulation of multiple oligozoospermic specimens for husband (homologous) insemination, 3) preservation of sperm prior to vasectomy, 4) collection and preservation of sperm from men who face permanent injury to spermatogenesis through an operation, chemotherapy or radiation, 5) to obviate the potential genetic danger of man's exposure to polution, and 6) availability of husband's sperm at ovulation.

SUMMARY AND CONCLUSION

The concern for evaluation and management of the male infertility has grown considerably in the last 20 years. Particularly, andrology, a new area of specialization of medical discipline inspires intensively the progress by understanding in reproductive endocrinology, sperm physiology, advanced diagnostic methods, modern medical treatment, and surgical skills including microsurgery. In this report, the author's experience with a total of 3,520 infertile male patients during the past 30 years (1955-1984) in the Infertility Clinic at the Dept. of Urology, Seoul National University Hospital was reviewed based on the pathophysiology, etiology, evaluation and management. These infertile males corresponded to 4.2% of total male out-patients of the Department. Duration of barren marital life was 4.5 years. Completion of spermatogenesis from spermatogonium to spermatozoon requires 74 ± 5 days. Causes of male infertility were faulty sperm transportation in 35%, faulty sperm production in 33%, faulty semen composition in 7%, faulty ejaculation in 3%, and idiopathic cause which is an eponym for ignorance in 22%. Normal testicular size of Korean males is 19ml. A man with a testicular volume of 10ml or less should be suspected as suffering from faulty spermatogenesis. Normal spermiogramme of our series reveals that volume is 2.7ml; counts, 120×10^6/ml; motility, 60%; viability, 64%; activity grade, 3; motility index, 180; and morphology, 80%.

Medical treatment was attempted to 723 infertile males using 12 different pharmacological compounds for average 2 courses (6 months). Spermiogramme improved in 28% and pregnancy resulted in 14% after the pharmacotherapy. Surgical therapy was applied to 1,119 infertile males. In vasovasostomy group (699 patients), anatomical success rates were 90%, and functional success rates, 51% by microsurgical anastomosis technique. In epididymovasostomy group (281 patients), patency rates were 37% and pregnancy rates, 20% by microsurgery. In varicocelectomy group, sper-

miogramme improved in 30% and pregnancy occurred in 20% of the patients who had the varicocelectomy. However, 33% of the patients with varicocele who did not have varicocelectomy could impregnate their sexual partners.

The author is quite confident that the urologist who is skilled in andrology can provide better and more rational care for these infertile males.

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= 국문초록 =

남성불임증 3,520례의 치험과 임상적 전망

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지난 30년(1955～1984) 동안에 치험한 남성불임증 환자 3,520례를 토대로 하여 발생병리, 진단 및 치료를 고찰하였다. 이들 남성불임증 환자는 동기간내에 비뇨기과 외래를 찾은 남자 환자의 4.2%에 해당한다. 이들의 평균 불임결혼기간은 4.5년이나 최근에 와서는 기간이 단축되어 3년이 되었다. 원시정모세포에서 완숙정자로 발전하는 정자형성기간은 74±5일이 된다. 불임증의 원인별로 볼 때, 수정(정자수송)장애가 가장 많아 35%가 되고, 조정(정자형성)장애가 33%, 정액성분장애가 7%, 사정장애가 3%, 그리고 원인미확인의 특발성 원인이 22%가 된다. 우리나라 정상성인의 고환크기는 19ml이다. 고환 크기가 10ml이하인 때는 정자형성장애가 의심된다고 판단하는 것이 좋을것 같다. 정액검사에서 그 정상치는 양이 2.7ml, 수가 120×10^6/ml, 운동성이 60%, 생존정자가 64%, 활동성정도가 3, 운동성지수가 180, 정상형태가 80%가 된다. 전체 남성불임증 환자 중에서 각종 치료에 응하여 1년 이상 지속관찰이 가능했던 1,842례(52%)에 대하여 평가하면 다음과 같다. 내과적 요법은 723례에게 시도되었다. 이들에게 시용된 약물은 12종에 이르며, 치료기간은 그 평균이 2단위(6개월)가 된다. 치료효과에서 정액소견이 치료전 보다 20%이상 호전된 예는 28%가 되고, 임신율은 14%가 된다. 외과적 요법은 1,119례에게 시도되었다. 정관정관문합술군 699례에서는 해부학적 성공율이 90%에, 기능적 성공율이 51%가 된다. (현미경적 시술군). 부고환정관문합술군 281례에서는 개통율이 37%에, 임신율이 20%가 된다.(현미경적 시술군). 정계정맥류절제술군 57례에서는 정액성분의 호전이 30%에, 임신율이 20%가 된다. 그러나 정계정맥류가 있으면서 정계정맥류 절제술을 받지 않은 환자중에서 임신시키는데 성공한 예는 33%가 된다.