JOURAA
ISSN 0022-5347
Volume 141 February 1989 Number 2

The Journal of UROLOGY®

FOUNDED IN 1917 BY HUGH HAMPTON YOUNG

Official Journal of the American Urological Association, Inc.

CONTENTS

CLINICAL UROLOGY

Contents continued on page A6

Annual Meeting, American Urological Association, Inc., Dallas, Texas, May 7–11, 1989

Contents continued from Cover 1

Urological Neurology and Urodynamics

Pediatric Articles

Editorial

Case Reports

INVESTIGATIVE UROLOGY

Contents continued on A10

Contents continued from page A6

UROLOGICAL SURVEY

Contents continued on page 414

Contents continued from page A10

Contents continued on page A16

Contents continued from page A14

INFORMATION FOR SUBSCRIBERS

The Journal of Urology is issued monthly. Two volumes are published each year beginning in January and July.

Correspondence concerning business matters should be addressed to the Subscription Department, Williams & Wilkins, 428 East Preston Street, Baltimore, Md. 21202 U.S.A.

Subscriptions should be renewed promptly—The publisher cannot guarantee to supply back issues on belated renewals.

Subscriptions, new or renewal, should be sent to Williams & Wilkins.

Bound copies of Volumes No. 141 and No. 142 will be available in early 1990 to subscribers only. The volumes will be hard bound in black buckrum, and the journal name, volume number, and year of issue will be stamped in gold on the spine. The cost for two volumes is $75.00 (plus an additional $10.00 for orders outside the U.S.). A $2.00 discount is given for advance payment. Orders must be received by the publisher before December 1, 1989.

Microfilm availability—Inquire of Williams & Wilkins.

Change of address—Publisher must be notified 60 days in advance.

Annual subscription rates—U. S. A. AND POSSESSIONS: personal, $130; institutional, $150; single copy, $14. FOREIGN: personal, $175; $252 Japan; institutional, $195, $272 Japan; single copy, $17. Institutional rate applies to libraries, schools, hospitals, clinics, group practices, and federal, commercial, and private institutions and organizations. (Japanese rates include air freight.) Subscription prices are subject to change. Japanese Yen price is available from our sole agent U.S.A.C.O. Corp., 13-12, Shimbashi 1-Chome, Minato-Ku, Tokyo 105, Japan, telephone 03-502-6471.

A special in-training discount rate of $60 ($105 foreign, $182 Japan) per year is available to residents, interns and students for a period of 3 years. In requesting this rate please indicate training status and name of institution. The special in-training discount rate can be extended to all participants in 4-year training programs, provided that sufficient proof of training status is supplied.

Reprints of individual articles are available only from authors.

New subscriptions are entered to begin with the first issue of the current volume. A check for payment in full should accompany order.

0022-5347/89/1412-0315$02.00/0
THE JOURNAL OF UROLOGY
Vol. 141, February
Printed in U.S.A.

PRIMARY ERECTILE DYSFUNCTION

CHRISTIAN GEORG STIEF,* WOLFGANG BÄHREN, WOLFGANG SCHERB AND HELMUT GALL

From the Departments of Urology, Radiology, Neurology and Psychiatry, and Dermatology, BWK, Academic Hospital of the University, Ulm and Department of Urology, University Clinics, Freiburg, West Germany

ABSTRACT

We evaluated 67 patients 18 to 60 years old (mean age 28.5 years) with primary erectile dysfunction (absence of full sustained erections since early childhood or puberty) using a multidisciplinary approach. Organic causes of the erectile dysfunction were found in 57 of the 67 patients (85 per cent): 12 (18 per cent) had neurological, 35 (52 per cent) arteriogenic and 35 (52 per cent) venogenic abnormalities. Psychogenic factors were diagnosed in 11 patients (16 per cent), while in 4 (6 per cent) a classification was not possible. Concomitant psychogenic abnormalities were found in 39 of the 57 patients (68 per cent) with organic primary erectile dysfunction. Our results suggest that primary erectile dysfunction is caused mainly by organic factors. However, for successful therapy the frequent secondary psychogenic abnormalities must be considered. (*J. Urol., 141: 315–319, 1989*)

In their pioneering study Kinsey and associates found a 0.4 per cent incidence of primary impotence in an unselected population of men less than 25 years old.[1] There is no further detailed description of these patients but it can be assumed that they had never been able to have intercourse. The definition of primary erectile dysfunction (that is the patient has never been able to have intercourse) was used first in the psychological and psychiatric literature.[2,3] Among these patients "some had partial erections too weak for intercourse, while others had normal erections under certain circumstances, but not others".[4] In up to 90 per cent of the patients primary erectile dysfunction was attributed to psychological factors.[2-4] Besides an extensive psychological examination, the diagnostic evaluation of possible organic factors consisted of a "thorough physical examination as well as appropriate laboratory testing of blood and urine samples".[4]

Within the last decade the development of new and refined diagnostic methods to evaluate erectile dysfunction[5-11] led to a new concept of impotence. Erectile dysfunction no longer is regarded as caused by a psychological or an organic factor but by several etiologies. This multifactorial genesis requires a multidisciplinary approach to assure the diagnosis of impotence. To elucidate possible etiological factors of primary erectile dysfunction we present an extensive study of 67 patients with absence of full sustained erection since puberty performed by a urologist, neurologist, psychiatrist, clinical psychologist, dermatologist and radiologist.

PATIENTS AND METHODS

We investigated multidisciplinarily 67 consecutive patients between 18 and 60 years old (mean age 28.5 years) with primary erectile dysfunction. Diagnostic evaluation in every patient included a history (with an emphasis on sexual function) obtained with the aid of a standardized questionnaire, physical examination, blood chemistry studies including SMA-12, glucose tolerance test, and determination of testosterone and prolactin levels. History, sexual case history and partner interview were done by a psychiatrist and psychological testing (Minnesota Multiphasic Personality Inventory) was performed by a clinical psychologist. Nocturnal penile tumescence monitoring with a Snap-Gauge† device,[5] Doppler studies of the 4 penile arteries proximally and distally,[6,7] ultrasound of the abdomen and large vessels (aorta and iliac arteries) and neurological examination, including bulbocavernosus reflex latency and somatosensory evoked potentials of the dorsal nerve of the penis,[8] were performed. A standardized diagnostic injection of a vasoactive drug mixture (15 mg./ml. papaverine hydrochoride and 0.5 mg./ml. phentolamine mesylate)[9] also was done.

Selective penile arteriography[10] was performed on 32 patients when an arterial disease was suspected by Doppler ultrasound as described and/or by standardized diagnostic injection of vasoactive drugs.[9] Arteriography was done with the penis in a fully tumescent but not rigid state after intracavernous injection of 0.5 to 1.5 ml. (depending on the erectile response to previous diagnostic intracavernous injections) of the standardized combination of papaverine and phentolamine. All pharmaco-arteriography studies were done bilaterally. The quality of the arteriograms was judged according to a rating scale of quality, with a minimum showing thick contrast medium in the main stem of the penile arteries (3), additional shunt vessels and helicine arteries (2) or filiform terminal branching of all penile vessels (1). Routinely, selective pharmaco-arteriography showed a mean quality of 1.7. Dynamic cavernosography[11] was done in 41 patients when a venous leak was suspected by Doppler ultrasound and/or standardized diagnostic injection of vasoactive drugs.

The diagnosis of primary or secondary psychogenic erectile dysfunction was dependent on the results of psychiatric evaluation, sexual case history, including psychosexual development, partner interview and psychological tests (the Minnesota Multiphasic Personality Inventory was only part of the evaluation to obtain a personality profile). Patients with primary psychogenic abnormalities had psychiatric disorders, such as major depression, and neurotic, generalized anxiety, obsessive-compulsive or personality disorders, as well as disturbed autonomic physiological functions with performance anxiety, vegetative signs, sleep disturbances and mood incongruent loss of sexual interest. Concomitant psychogenic abnormalities to organogenic erectile dysfunction included reactive depression, performance anxiety, mood congruent loss of sexual interest and partner conflicts.

A bulbocavernosus reflex latency exceeding 42 msec. was interpreted as pathological. The response to intracavernous injection was considered to be pathological if repeated injection of 0.5 ml. of the vasoactive drug mixture (corresponding to 7.5 mg. papaverine plus 0.25 mg. phentolamine) did not induce a full erection.[9] The anatomy of the penile arteries was considered to be pathological if severe hypoplasia or aplasia of both cavernous arteries was diagnosed by angiography or if the Doppler

Accepted for publication June 24, 1988.
*Current address: Department of Urology, University Clinics, Hugstetterstr. 55, D-7800 Freiburg, Federal Republic of Germany.
†Dacomed, Minneapolis, Minnesota.

study after intracavernous injection of vasocative drugs showed no or a significantly reduced flow in both cavernous arteries compared to normal potent men. We used the classification of Gall and associates of penile arterial malformations in patients with primary erectile dysfunction: 1) no significant disturbance of penile arterialization—unilateral malformation (hypoplasia or aplasia of 1 penile artery, hypoplasia of 2 penile arteries or unilateral arterial supply of both cavernous bodies) and 2) pathological penile arterialization—bilateral malformation (bilateral hypoplasia or aplasia of the cavernous arteries or complex malformation) and arteriovenous malformation.[12] One aplastic or hypoplastic dorsal penile artery or 1 aplastic or hypoplastic cavernous artery was not considered to be pathological because these abnormalities also were observed in normally potent young men[7] and because these men showed a normal reaction to diagnostic intracavernous injections.[9] In previous studies the Doppler results correlated with angiography in 94.5 per cent of the patients.[7] For cavernosometry a maintenance flow exceeding 80 ml. per minute was considered to be pathological and suggestive of venous disease.[13] The cavernous outflow was radiologically documented in at least the anteroposterior and oblique projection. In a previous study the rate of the maintenance flow corresponded well with the response to standardized intracavernous injections of vasoactive drugs ($p < 0.05$, Student's t test).[14]

RESULTS

No patient had a history of pelvic, spinal cord or skull trauma, or a prior pelvic operation. Furthermore, no neurological or internal disease was found on physical examination. All patients had normal blood chemistry studies and hormone levels. One patient with a testosterone level in the lower normal range had failed prior androgen supplement therapy.

Three patients reported no erections at all, while 41 reported erections with insufficient rigidity for intromission and 7 had short-lasting full erections with detumescence occurring only seconds after full rigidity was achieved. A total of 16 patients reported a combination of insufficient rigidity and short-lasting, semirigid erections. In all patients erectile disturbances had been present since early childhood or puberty.

Psychiatric evaluation, partner interview, sexual case history and psychometric tests suggested a psychogenic etiology for the primary erectile dysfunction in 11 of 67 patients (16.4 per cent), including 5 who also had an organic etiology. Nonetheless, 39 of 57 (68.4 per cent) patients with organic primary erectile dysfunction had concomitant psychogenic abnormalities.

Although the neurological examination failed to reveal an underlying neurological disease in any case, the bulbocavernosus reflex latency and/or somatosensory evoked potentials of the dorsal nerve of the penis were pathological in 12 of 67 patients (17.9 per cent). No sign of arterial insufficiency was found on physical examination or ultrasound of the abdominal aorta or iliac arteries. However, 35 of 67 patients showed pathological penile arterialization. Of 32 patients who underwent angiography 21 showed significant hypoplasia or aplasia of both cavernous arteries (fig. 1), and in 1 angioma was found (fig. 2). In 6 patients angiography revealed normal penile arterialization, while 4 had an arterial abnormality (fig. 3) that was not considered to be of major hemodynamic relevance. A total of 13 patients had significant abnormalities of both cavernous arteries by Doppler ultrasound. In 2 patients Doppler ultrasonography showed absent flow on 1 side with normal flow on the opposite side. Including these 2 patients, penile arterialization was not significantly disturbed hemodynamically in 32 patients (in 10 by angiography and Doppler ultrasound, and in 22 by Doppler ultrasound alone).

A venous leakage was found in 35 of 67 patients: diagnosed in 27 by abnormal cavernosometry and cavernosography, and

FIG. 1. Pharmaco-arteriography in 25-year-old patient with primary erectile dysfunction shows bilateral arterial malformation. *A*, selective right arteriography shows minor degree of hypoplasia of dorsal penile artery and aplasia of cavernous artery. *B*, selective left arteriography shows normal dorsal penile artery and extremely hypoplastic doubled cavernous artery.

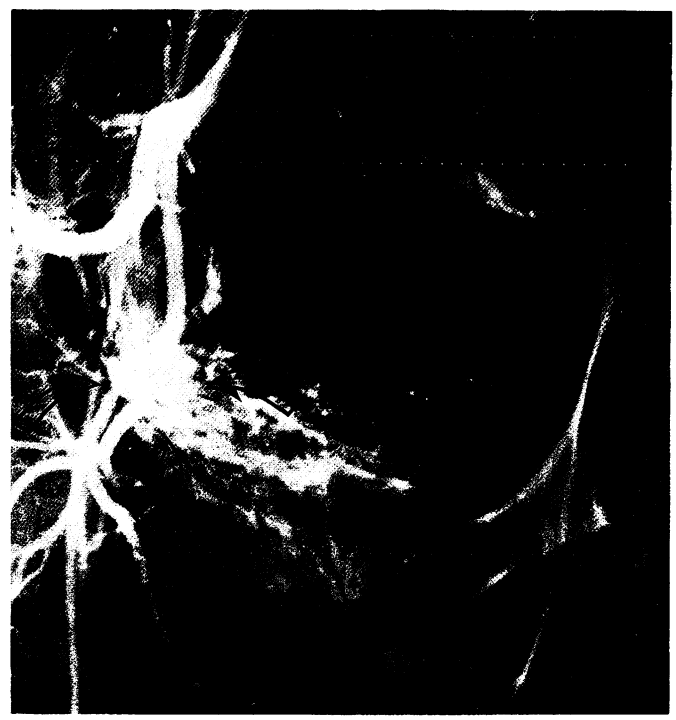

FIG. 2. Pharmaco-arteriography in 25-year-old patient with primary erectile dysfunction shows arteriovenous malformation with massive venous drainage to right internal iliac vein early in arteriogram.

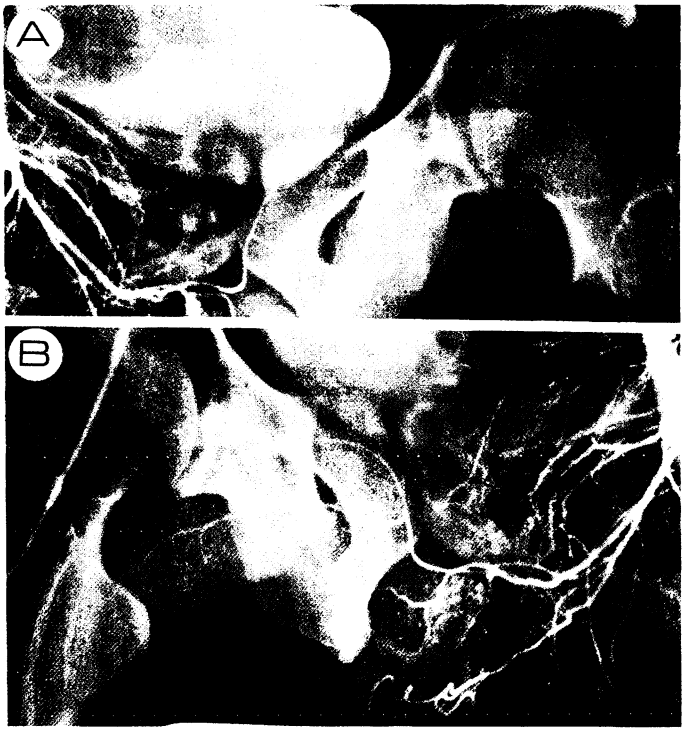

FIG. 3. Pharmaco-arteriography in 24-year-old patient with primary erectile dysfunction. *A*, selective right arteriography shows minor degree of hypoplasia of dorsal penile artery and severely hypoplastic cavernous artery. *B*, selective left arteriography reveals normal left penile arterialization with slightly reduced arterial diameter.

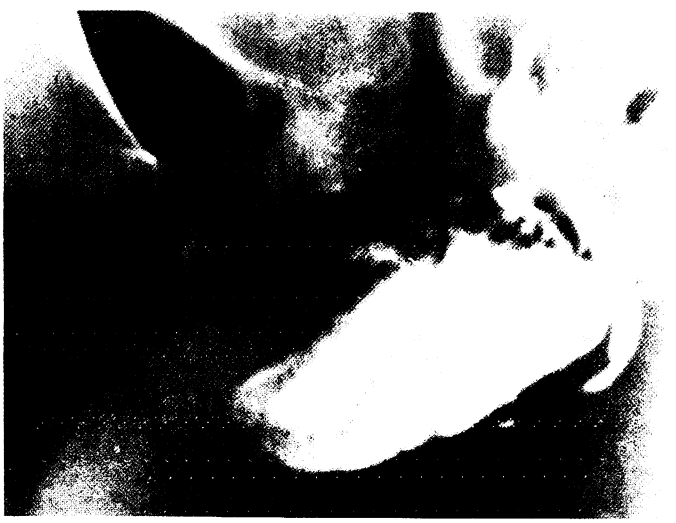

FIG. 4. Dynamic cavernosography in 21-year-old patient with primary erectile dysfunction shows localized abnormal cavernous drainage on left side of penile shaft.

in 8 by abnormal cavernosography alone. Dynamic cavernosometry showed a mean pathological cavernosal outflow of 176 ml. per minute (range 90 to 300) in 19 patients, while in 8 a flow of 300 ml. per minute could not induce a full erection. In these 27 patients cavernosography showed abnormal cavernous drainage via the deep and superficial dorsal veins. In addition, localized abnormal cavernous drainage via a circumscript area of the penile shaft was found in 12 of these patients (fig. 4), while in 8 an opacification of the cavernous veins and/or of shunts to the glans and corpus spongiosum were seen. In 8 patients despite normal cavernosometry the response to injection of vasoactive drugs was pathological and abnormal cavernous drainage was found via a single ectopic vein to the saphenous vein (mean maintenance flow 67 ml. per minute) on cavernosography.[15] Of 41 patients 6 showed venous competence on cavernosometry and cavernosography (tables 1 and 2).

TABLE 1. *Etiology of primary erectile dysfunction according to multidisciplinary findings*

Etiology	No. Pts.
Arterial plus venous	15
Venous	14
Arterial	12
Psychogenic	6
Arterial plus neurogenic	5
No classification possible	4
Venous plus psychogenic	3
Neurogenic	2
Venous plus neurogenic	2
Arterial, neurogenic plus psychogenic	1
Arterial, venous plus neurogenic	1
Arterial plus psychogenic	1
Venous, neurogenic plus psychogenic	1

TABLE 2. *Over-all etiologies of primary erectile dysfunction*

Etiology	No. Pts. (%)
Arterial	35 (52.2)
Venous	35 (52.2)
Neurogenic	12 (17.9)
Psychogenic	11 (16.4)
Unknown	4 (5.9)

The response to standardized intracavernous injections corresponded well with the penile hemodynamic status. Twelve patients with intact penile hemodynamics required a mean of 0.48 ml. of the vasoactive drug mixture to achieve a full erection, while 20 with arterial etiology and venous competence required a mean of 0.97 ml. Of 35 patients with venous incompetence 13 required a mean of 1.67 ml. to induce a full erection and 22 could not reach full erections with the maximal dose of 3 ml. (corresponding to 45 mg. papaverine and 1.5 mg. phentolamine).

DISCUSSION

Kinsey and associates found an incidence of primary erectile dysfunction of 0.4 per cent in an unselected population of men less than 25 years old.[1] Graber reported primary erectile dysfunction in 31 of 157 impotent patients (19.7 per cent).[16] In other large series of impotent patients the incidence of primary erectile dysfunction was approximately 1 to 2 per cent.[17,18] In our series primary erectile dysfunction occurred in 67 of 573 consecutive patients (11.7 per cent) with erectile dysfunction lasting at least 1 year. We believe that these differences in rate reflect a preselection of patients. As a military hospital (BWK Ulm), more than 25 per cent of our patients referred to the impotence clinic are soldiers of a mostly younger age. Additionally, we exclude patients more than 65 years old from our impotence program to avoid possible side effects of the diagnostic intracavernous injections of vasoactive drugs. Further studies are needed to reveal the incidence of primary erectile dysfunction in the entire population.

Kolodny and associates,[19] and Kaplan[20] estimated that 10 to 20 per cent of all cases of erectile dysfunction are caused primarily by organic factors, while in another 15 per cent organic factors may contribute to impotence. The discrepancy of these estimations (about a third of the patients with primary erectile dysfunction having pure or concomitant organic causes)

and our findings (85 per cent organogenic causes) cannot be explained solely by the limited organic evaluation in the aforementioned studies. We believe that this discrepancy is due mostly to the preselection of patients with primary erectile dysfunction: patients with congenital penile deviations and subsequent erectile dysfunction during the first attempts at intercourse but full erections during masturbation fulfill the criteria of primary erectile dysfunction in the psychological literature.[19-21] However, these patients would not fulfill our criterion of primary erectile dysfunction, which is absence of full sustained erections since puberty.

Severe hypoplasia or aplasia of both cavernous arteries with subsequent insufficient blood supply to the cavernous bodies seems to have a key role in primary erectile dysfunction. A pathological cavernous inflow was noted in 35 of the 57 patients with an organic etiology and in 12 it was the only cause of the primary erectile dysfunction. This arterial malformation seems to be limited to the penile vasculature, since angiography showed no other abnormalities in any patient except 1 with angioma. Zorgniotti and associates also found angioma to be the cause of impotence in a patient with primary erectile dysfunction.[22] Since only 1 of 29 patients who underwent selective angiography of the penis had angioma the incidence of this anomaly is relatively low. Nonetheless, it is important, since it is a potentially curable problem. The high incidence of abnormal penile arterialization as the cause of primary erectile dysfunction is in accordance with the findings of Michal and associates who noted abnormal phalloarteriography findings in 75 per cent of the patients with primary erectile dysfunction.[23]

Like the pathological arterial supply to the cavernous bodies, abnormal cavernous drainage is a major factor in the etiology of primary erectile dysfunction. Of our 57 patients with an organic etiology 35 had a pathological cavernous outflow on cavernosography and in 14 it was the only cause of impotence. In 20 of 35 patients with venous leakage cavernosography did not show a diffuse or generalized cavernous outflow but pathological drainage via 1 or several well defined veins was noted. Similarly, Ebbehøj and Wagner reported a venous fistula between the corpus cavernosum and glans to be the cause of primary erectile dysfunction in 1 patient, who achieved full erection after ligature of this shunt.[24] Our cavernosographic findings and this case report suggest that a localized abnormality in the venous closing mechanism[25] might be a frequent cause of primary erectile dysfunction instead of generalized cavernous insufficiency.[26]

Neurological examination revealed no particular neurological disease. The absence of generalized pathological neurological findings in the presence of abnormalities of the bulbocavernosus reflex latency and/or somatosensory evoked potentials in 12 patients suggests a possible underlying neurological disease as the cause of primary erectile dysfunction. However, measurement of bulbocavernosus reflex latency and somatosensory evoked potentials evaluates only the somatosensory penile nerve supply[27] and not the function of the autonomous nervous system (cavernous nerve). To date there is no way to examine these nerves and further studies are necessary to reveal involvement of the autonomic nervous system.

There is a high incidence of isolated or combined arterial, venous or neurogenic abnormalities in our patients with primary erectile dysfunction. In these patients primary erectile dysfunction probably results from abnormal embryogenesis of the penis and in some cases from early psychosocial maldevelopment. The possibility of abnormal penile embryogenesis as the cause of primary erectile dysfunction is supported by the recent experimental findings of impotence due to a spontaneous gene mutation.[28] Since the majority of the patients have secondary psychological disturbances, an early and complete diagnostic study with individualized therapy is recommended for all patients with primary erectile dysfunction.

Drs. F. Benard, R. Bosch and B. Kogan provided constructive discussion.

REFERENCES

1. Kinsey, A. C., Pomeroy, W. B. and Martin, C. E.: Sexual Behavior in the Human Male. Philadelphia: W. B. Saunders Co., 1948.
2. Masters, W. H. and Johnson V. E.: Human Sexual Inadequacy. Boston: Little, Brown & Co., 1970.
3. Johnson, J.: Disorders of Sexual Potency in the Male. Oxford: Pergamon Press, 1968.
4. Masters, W. H., Johnson, V. E. and Kolodny, R. C.: Human Sexuality. Boston: Little, Brown & Co., 1986.
5. Ek, A., Bradley, W. E. and Krane, R. J.: Nocturnal penile rigidity measured by the Snap-Gauge band. J. Urol., **129:** 964, 1983.
6. Jevtich, M. J.: Non-invasive vascular and neurologic tests in use for evaluation of angiogenic impotence. Int. Angio., **3:** 225, 1984.
7. Gall, H., Bähren, W., Scherb, W., Stief, C. G. and Thon, W.: Diagnostic accuracy of Doppler ultrasound technique of the penile arteries in correlation to selective arteriography. J. Cardiovasc. Intervent. Rad., in press.
8. Parys, S. T., Evans, C. M. and Parsons, K. F.: Bulbocavernosus reflex latency in the investigation of diabetic impotence. Brit. J. Urol., **61:** 59, 1988.
9. Stief, C. G., Bähren, W., Gall, H. and Scherb, W.: Functional evaluation of penile hemodynamics. J. Urol., **139:** 734, 1988.
10. Bookstein, J. J., Valji, K., Parsons, L. and Kessler, W.: Pharmacoarteriography in the evaluation of impotence. J. Urol., **137:** 333, 1987.
11. Virag, R., Spencer, P. P. and Frydman, D.: Artificial erection in diagnosis and treatment of impotence. Urology, **24:** 157, 1984.
12. Gall, H., Bähren, W., Stief, C. G., Scherb, W. and Thon, W.: Arterial anatomy and arteriographic diagnosis of arteriogenic impotence. J. Cardiovasc. Intervent. Rad., in press.
13. Wespes, E. and Schulman, C. C.: Parameters of erection. Brit. J. Urol., **56:** 416, 1984.
14. Stief, C. G. and Wetterauer, U.: Quantitative and qualitative analysis of dynamic cavernosographies in erectile dysfunction due to venous leakage. Urology, in press.
15. Stief, C. G., Gall, H., Scherb, W. and Bähren, W.: Erectile dysfunction due to ectopic penile vein. Urology, **31:** 300, 1988.
16. Graber, G.: Classification of erectile failure. In: Impotence: Physiological, Psychological, and Surgical Diagnosis and Treatment. Edited by G. Wagner and R. Green. New York: Plenum Press, p. 92, 1981.
17. Lue, T. F.: Personal communication.
18. Juenemann, K.-P.: Personal communication.
19. Kolodny, R. C., Masters, W. H. and Johnson, V. E.: Textbook of Sexual Medicine. Boston: Little, Brown & Co., 1979.
20. Kaplan, H.: The Illustrated Manual of Sex Therapy. New York: Quadrangle, 1975.
21. Janssen, P. L.: Zur Differenzierung und Spezifität der Psychodynamik funktioneller Sexualstörungen bei Mannes. Zschr. Psychosom. Med. Psychoanal., **32:** 27, 1986.
22. Zorgniotti, A. W., Padula, G. and Rossi, G.: Impotence caused by pudendal arteriovenous fistula. Urology, **14:** 161, 1979.
23. Michal, V., Pospíchal, J. and Blažková, J.: Arteriography of the internal pudendal arteries and passive erection. In: Vasculogenic Impotence. Edited by A. W. Zorgniotti and G. Rossi. Springfield, Illinois: Charles C Thomas, Publishers, part IV, chapt. 19, p. 169, 1980.
24. Ebbehøj, J. and Wagner, G.: Insufficient penile erection due to abnormal drainage of cavernous bodies. Urology, **13:** 507, 1979.
25. Lierse, W.: Blood vessels and nerves of the human penis. Urol. Int., **37:** 145, 1982.
26. Lue, T. F. and Tanagho, E. A.: Physiology of erection and pharmacological management of impotence. J. Urol., **137:** 829, 1987.
27. Sarica, Y. and Karacan, I.: Bulbocavernosus reflex in somatic and visceral nerve stimulation in normal subjects and in diabetics with erectile impotence. J. Urol., **138:** 55, 1987.
28. Chubb, C. and Henry, L.: Impotence induced by a single gene mutation. Biol. Reprod., **36:** 557, 1987.