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Intra-individual Comparative Study of Dynamic and Pharmacocavernography

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Summary—A series of 65 consecutive patients with suspected venous leakage as a cause of their erectile dysfunction underwent dynamic and pharmacocavernometry/cavernography. This comparison of methods for diagnosing venous leakage produced divergent findings in 25/65 patients (38.5%). Because of its theoretical advantages, pharmacocavernometry/cavernography is recommended for the diagnosis of venous leakage.

Newman *et al.* (1964) were the first to describe the phenomenon of passive erection by perfusion of the cavernous bodies or the internal iliac artery. Virag *et al.* (1979) induced artificial erection by saline perfusion of the cavernous bodies in the diagnosis of erectile dysfunction. The lowest rate of saline perfusion required to maintain full erection was known as maintenance flow (cavernometry). In full erection, the penis was then perfused to opacify the abnormally draining veins (cavernography).

Lue *et al.* (1984) and Juenemann *et al.* (1985) showed that the cavernous haemodynamic changes which follow direct neurostimulation are similar to those following the intracavernous injection of vasoactive drugs. It was therefore suggested that cavernometry/cavernography should be done after pharmacologically induced cavernous relaxation (Lue *et al.*, 1986). The purpose of this study was to establish possible differences in the diagnostic information provided by dynamic and pharmacocavernometry/cavernography.

Patients and Methods

In all patients attending our impotence clinic the following investigations were done: a detailed history was taken with the aid of a questionnaire, with the emphasis on sex life, possible risk factors and situation-related erection processes and libido. Physical and neurological examination, SMA 12 including testosterone and prolactin and nocturnal

penile tumescence (NPT) measurements by means of a Jonas snap-gauge were followed by Doppler studies of both dorsal and cavernous penile arteries, proximally and distally, after the intracavernous injection of vasoactive drugs (Jevtich, 1984). Standardised intracavernous injections of a combination of papaverine and phentolamine were then given (Stief *et al.*, 1988).

Venous leakage was suspected if the patient did not respond with a full erection to maximum doses of vasoactive drugs (45 mg papaverine and 1.5 mg phentolamine) or if he showed intact penile arterialisation in Doppler studies (good blood flow in at least one cavernous and dorsal penile artery (Gall *et al.*, 1988)) after the intracavernous injection of vasoactive drugs and a poor erectile dysfunction was also an indication for cavernometry/cavernography, since previous studies showed that almost half of these patients had venous leakage.

In 65 consecutive impotent patients with suspected venous leakage, dynamic and pharmacocavernometry/cavernography were performed one after the other in the same patient. Under sterile conditions, the right proximal cavernous body was punctured without local anaesthesia for perfusion with a 19 gauge butterfly cannula. A Fresenius perfusion pump mixed a maximal perfusion rate of 400 ml/min (model BP 742, Fresenius AG, Bad Homburg, FRG) was used for flow rates from 40 to 300 ml/min. For flow rates lower than 40 ml/min the perfusion was done by a urologist with a 60-ml syringe because it is more accurate than the pump in this flow range. A 26 gauge needle was inserted

into the contralateral cavernous body for intracavernous pressure recording.

For dynamic cavernography, 0.9% saline (37°C) was perfused at a rate of 300 ml/min to induce a full erection (80 mm Hg). If a full erection was not induced within 90 s we proceeded directly to contrast medium (Ultravist 300, Schering AG, Bergkamen, FRG; Solustrast, 300, Byk Gulden, Konstanz, FRG) perfusion to avoid circulatory problems. After measuring the maintenance flow (mf 1) and following opacification of the cavernous drainage, 30 mg papaverine and 1 mg phentolamine were injected intracavernously; 10 min later, measurement of the maintenance flow (mf 2) and opacification of the cavernous drainage were repeated (pharmacocavernometry/cavernography).

To prevent possible endothelial changes caused by the hyperoncotic contrast medium, the penis was perfused with 30 to 50 ml saline. To prevent intradermal or subcutaneous haematomas after the needles were removed, the puncture sites were compressed manually for at least 5 min.

As a control group, 14 patients with congenital penile deviation underwent dynamic cavernometry/cavernography. A further 8 patients with congenital penile deviation underwent pharmacocavernometry/cavernography.

Results

In the control group for dynamic cavernometry, the

maintenance flow was 18 to 65 ml/min (mean 41). For pharmacocavernometry, the maintenance flow in the control group was 4 to 14 ml/min (mean 7). Only slight cavernosal drainage (or none at all) was seen during contrast medium perfusion in both groups (Fig. 1).

Primary erectile dysfunction was noted in 17/65 patients: 6 had insulin-dependent diabetes; impotence was related to a pelvic fracture in 4 patients and 3 had had Peyronie's disease for at least 1 year; in 1 patient, impotence developed after iatrogenic sphincterotomy during TUR of the prostate. No patient had hormonal abnormalities. Investigations revealed concomitant arterial disease in 21/65 patients. Neurological abnormalities were suspected in 5 and concomitant psychogenic abnormalities in 3.

The maintenance flow in dynamic cavernometry was 35 to 275 ml/min (mean 103) in 41 patients. The induction flow (300 ml/min) failed to induce full rigidity in 24 patients. In pharmacocavernometry the maintenance flow was 3 to 220 ml/min (mean 55) in 63 patients. Full rigidity could not be induced in 2 cases.

When the patients were divided into 2 groups, 1 achieving full rigidity in dynamic cavernometry and the other failing to do so, it was found that those who did not attain full rigidity (mf 1 > 300 ml/min) had a markedly higher mf 2 (22 patients 5–220 ml/min, mean 112 ± 89 ; 2 patients > 300 ml/min) than those achieving full rigidity (mf 3–220 ml/min, mean 45 ± 33). This difference was statistically significant (Student's *t* test: $P = 0.001$).



Fig. 1 Normal cavernography. No drainage or only slight cavernosal drainage is visible. (A) antero-posterior. (B) oblique.

Eight patients had abnormal dynamic cavernometry and normal pharmacocavernometry with corresponding cavernography (Fig. 2). In 3 patients, dynamic cavernometry/cavernography was normal, but pharmacocavernometry/cavernography was abnormal. In 11/65 patients with abnormal cavernous drainage via superficial and deep dorsal penile veins in dynamic cavernography, pharmacocavernography revealed the drainage to be via the superficial vein(s) to the saphenous vein(s) (Fig. 3): 3/10 patients with abnormal drainage via deep dorsal and cavernous veins in dynamic cavernography did not show cavernous veins in pharmacocavernography.

In 40/65 patients, identical findings were noted in dynamic and pharmacocavernometry/cavernography: 32 had venous leakage and 8 had normal cavernous drainage. In 4 patients, abnormal cavernous drainage was via a superficial penile vein to the cavernous vein. (Fig. 4).

Apart from 12 small ecchymoses on the site of the 19 gauge needle, we saw 2 cases of extensive subcutaneous oedema. One occurred during saline perfusion and was resorbed within hours. The other occurred during contrast medium perfusion and caused continuous penile shaft swelling due to the hyperoncotic contrast medium. This was also

resorbed without therapy within 2 days. One patient reported dizziness on cavernography; 2 complained of intrapenile pain during saline perfusion, which could not be treated by changing the position of the butterfly cannula. There was no subcutaneous infection or cavernitis.

Discussion

The maintenance flow established for dynamic cavernometry in the control group confirms the findings of other investigators (Porst *et al.*, 1987). The parameters for pharmacocavernometry are similar to those for psychogenic-impotent patients (Wespes *et al.*, 1986).

Five of 8 patients in the control group for pharmacocavernometry did not have full erections at the end of pharmacocavernometry/cavernography despite an adequate dose of vasoactive drugs. We attribute this to the elevated intracavernous adrenergic tonus (Buvat *et al.*, 1986) and to a wash-out effect by the saline perfusion. To prevent a prolonged erection in 3/8 patients with remaining high intracavernous pressures (over 80 mm Hg) over 10 min after the end of the procedure, 2 mg metaraminol were injected intracavernously (Brindley, 1984).

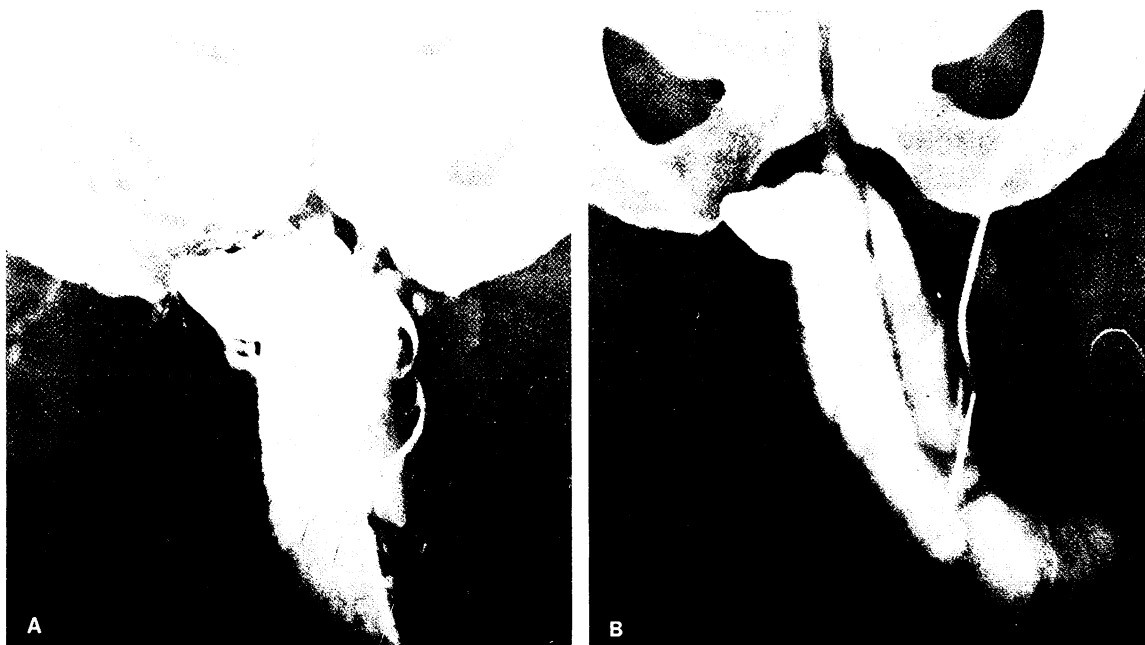


Fig. 2 (A) Dynamic cavernography with abnormal drainage via the dorsum penis. (B) Pharmacocavernography in the same patient shows normal findings.

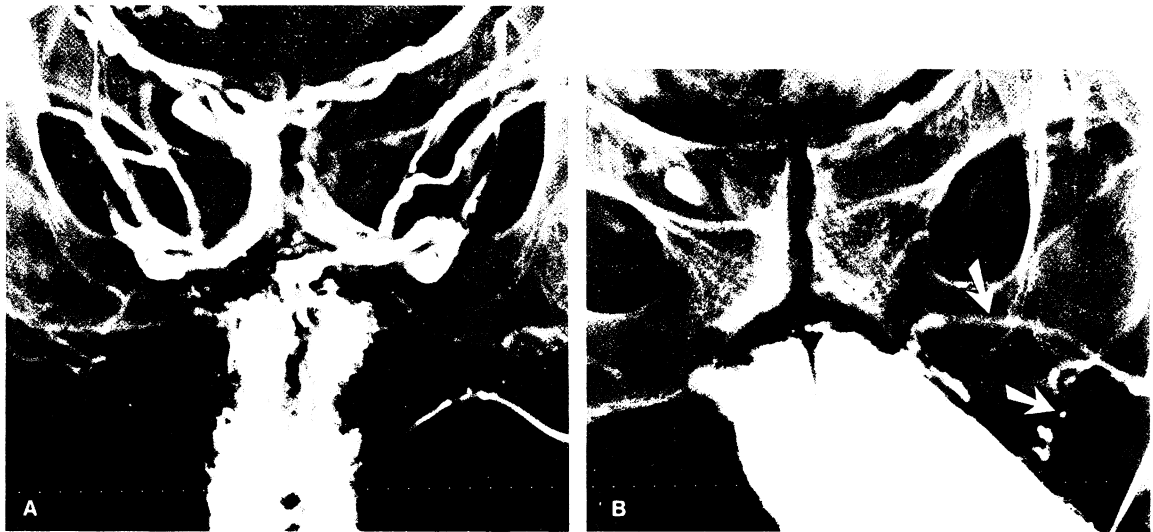


Fig. 3 (A) Dynamic cavernography shows abnormal drainage via the dorsum penis and ectopic veins. (B) Pharmacocavernography in the same patient shows the abnormal drainage only via ectopic veins (arrows).



Fig. 4 Abnormal cavernous drainage via an ectopic vein (large arrow); there is no drainage via the deep dorsal penile vein (small arrow).

The venous occlusive mechanism for penile erection consists of at least 2 phenomena: firstly, the emissary veins, running obliquely through the tunica albuginea, are squeezed during tumescence (Lierse, 1982); secondly, the venular plexus interposed between the tunica albuginea and the sinusoidal spaces is compressed following relaxation of the cavernous smooth muscles (Fournier *et al.*, 1987). Saline perfusion of the cavernous bodies

seems to imitate only the first part of the venous occlusive mechanism, whereas saline perfusion after cavernous smooth muscle relaxation seems to imitate both parts. These different targets could explain the different intra-individual findings: 25/65 consecutive patients (38.5%) showed different results in dynamic and pharmacocavernometry/cavernography respectively. This is of decisive importance because cavernometric and cavernographic findings are a major contribution to the indications for venous surgery.

Our comparative study shows that the results of dynamic cavernometry/cavernography cannot be compared with those of pharmacocavernometry/cavernography in all patients. The latter procedure should be used because of the theoretical advantages in imitating the physiological erection. This must be corroborated by further experimental studies and long-term results of venous leak surgery. In addition, it offers practical advantages such as savings in saline and contrast medium solution.

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