

INTRACAVERNOUS INJECTION THERAPY FOR RECOVERY OF SPONTANEOUS ERECTION (NOT FOR SELF-INJECTION)

—ITS MECHANISM AND INDICATIONS—

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Ten impotents underwent intracavernous injection therapy for recovery of spontaneous erection using papaverine hydrochloride alone or in combination with phentolamine. Six out of ten patients recovered spontaneous erection. Almost all respondents tended to have low initial penile-brachial-index values and their penile-brachial-index values rose after treatment. We concluded that periodic erections after using a vasoactive drug may have the effect of stimulating and activating the lethargic blood flow system and finally revitalizing the erectile organ.

Key words: Intracavernous injection, Impotence, Penile-brachial-index, Papaverine hydrochloride, Recovery of spontaneous erection

INTRODUCTION

Some vasoactive drugs have been used in the diagnosis and treatment of impotence after Virag's¹⁾ and Brindley's²⁾ reports. There have been several reports of 10 to 65%³⁻⁵⁾ recovery of spontaneous erection after vasoactive drug injection for diagnostic or other purposes into the corpus cavernosum of the penis. There have been few reports, however, of the use of vasoactive drugs specifically for the recovery of spontaneous erection; and the mechanism, indication and complications of the treatment have not yet been studied systematically. We, therefore, performed a preliminary clinical study to establish the therapy involving intracavernous vasoactive drug injections for the purpose of recovery of spontaneous erection.

MATERIALS AND METHODS

Ten consenting patients suffering from erectile impotence entered the protocol. The patients' ages ranged from 24 to 75 with an average age of 48.5 years. Each patient was selected only if he could achieve satisfactory erection after an injection into the corpus cavernosum of papaverine hydrochloride either alone or in

combination with phentolamine. All patients suffered from secondary impotence: two of them had previously undergone ligation of the deep dorsal vein. Their impotence occurred insidiously, with no clear underlying cause except for diabetes in one, and atherosclerosis in another.

Doses of vasoactive drugs adequate to maintain satisfactory erection for 30 to 90 min were determined for each individual. Established doses were 20 mg of papaverine in one, 30 mg in one, 40 mg in two, 60 mg in two and 80 mg in four. Two of the four 80 mg patients were injected with papaverine combined with 2 mg of phentolamine.

After determination of adequate doses, all patients were injected intracavernously once a week for 5 to 10 weeks by a single designated physician. For vasoactive drug injection, a 27 gauge single needle was inserted at a 90 degree angle into the lateral corpus cavernosum at mid-shaft without anesthesia after the penis surface was sterilized. There was no dilution of the vasoactive drugs and no use of a constrictive technique at the base of the penis.

Before and after the course of injections, we checked the liver function in each patient. Penile-brachial-index (PBI) meas-

uring was done at initial treatment, 5 weeks later, and after the course. For the PBI a 9.5 MHz doppler device and a 42 mm cuff were used to measure the systolic pressure of the penile dorsal arteries. The PBI was calculated by dividing the systolic pressure in the penile dorsal arteries by the systolic brachial pressure, and recording the higher of the left and right indices.

RESULTS

Six out of 10 patients recovered spontaneous erectile capability in response to normal stimulus after the 3rd to 7th injection. The effect continued for only 1 month in 2 patients, but well over 6 months in the other 4. The course of injections was continued for 10 weeks in 6 patients, but stopped after the 5th to 7th injection in 4 because of recovery of spontaneous erection.

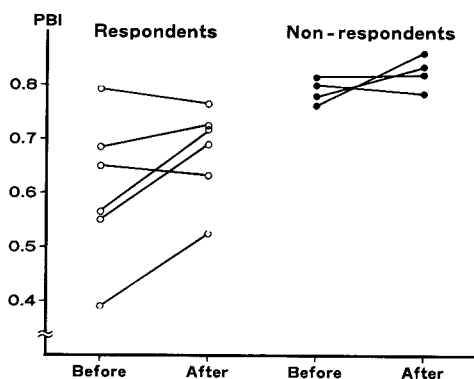


Fig. 1. Changes in PBI value by group before and after injection course

Fig. 1. shows the changes in the PBI value before and after the course. Five of the 10 patients had a low PBI value (<0.7) before treatment. All these 5 patients responded well to the treatment and the PBI value increased by more than 0.1 point after the treatment in all except one. Four non-respondents had normal PBI values before treatment and showed no change in PBI value at all.

Two of the four non-respondents entered a subsequent self injection program after the course described here. One of the remaining two recovered erectile capability after ligation of the deep dorsal vein for

venous incompetence, diagnosed with cavernosometry by the high flow rate needed to maintain erection. The remaining patient dropped out.

No patient showed liver function abnormality after treatment. All patients complained of local pain at the injected site each time, but all patients could tolerate it and no one requested that the therapy be stopped. One patient suffered a subcutaneous hematoma due to technical failure. Another suffered from priapism after the third injection (30 mg of papaverine) which was successfully cured with dopamine. He continued the course of injections to the end, but finally entered the self injection program with 20 mg of papaverine due to non-recovery of sexual potency.

DISCUSSION

The success rate of this treatment was 60%. Although the efficacy of this therapy for impotents is not conclusive due to the small subject sample, clearly some impotents could regain erection by this treatment. Surprisingly, almost all the respondents tended to have low initial PBI values and their PBI values rose after treatment. On the other hand all non-respondents had normal initial PBI values. It seems, therefore, that only patients with arterial problems as a cause for impotence respond well to this treatment, and the increase of penile blood flow in these patients acts for recovery of spontaneous erection.

Papaverine hydrochloride relaxes the smooth muscle of the corpus cavernosum. But how does the relaxing of the smooth muscle itself affect the corpus cavernosum and erectile mechanism? Bernoulli's law provides the key.

To apply Bernoulli's law, let the pressure and blood flow equal P_A and V_A in the penile artery, P_0 and V_0 in the corpus cavernosum in flaccid state and P_1 and V_1 in the corpus cavernosum during relaxing of the smooth muscle (Fig. 2).

Then,

$$P_A + \frac{1}{2}\rho V_A^2 = P_0 + \frac{1}{2}\rho V_0^2 = P_1 + \frac{1}{2}\rho V_1^2 \dots (1)$$

If we let S equal the cross-sectional area,

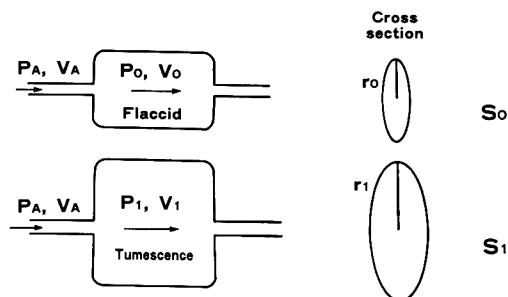


Fig. 2. Schematic drawing of penile inflow, the cavernosum, and outflow.

and r the radius, then formula (2) can be obtained because the product of area and blood flow is constant ($V_0 S_0 = S_1 V_1$).

$$V_1 = \left(\frac{r_0}{r_1}\right)^2 V_0 \quad \dots\dots\dots (2)$$

The changes in pressure (ΔP) induced by kinetic energy after the change in the radius is explained by formula (3).

$$\begin{aligned} \Delta P = P_1 - P_0 &= \frac{1}{2} \rho \left\{ 1 - \left(\frac{r_0}{r_1}\right)^4 \right\} V_0^2 \\ &= \frac{1}{2} \rho \left\{ 1 - \left(\frac{r_0}{r_0 + \Delta r}\right)^4 \right\} V_0^2 \quad \dots\dots\dots (3) \end{aligned}$$

This formula shows that if the radius of the corpus cavernosum is increased from r_0 to r_1 due to relaxation of the cavernous muscle, the pressure in the corpus cavernosum increases. Thus, an increase in capacity can be produced by the relaxing of the cavernous muscle without any change in blood flow.

Under actual clinical conditions, the blood flow in the penile artery increases when a vasoactive agent is injected into the corpus cavernosum. Fig. 3 indicates the changes in blood flow in the intrapenile

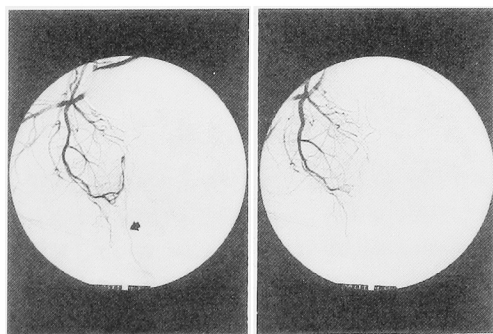


Fig. 3. Digital subtraction angiography. The arrow (left) indicates intrapenile artery after papaverine injection.

artery before (right) and after (left) papaverine injection into the corpus cavernosum.

The use of a vasoactive drug injected into the corpus cavernosum results in the drawing of blood from the penile artery into the corpus cavernosum. Generally there is only a small blood flow in the intrapenile artery and corpus cavernosum of impotents prior to treatment. Periodic erections after using a vasoactive drug may have the effect of stimulating and activating the lethargic blood flow system and finally revitalize the erectile organ. However this treatment is useful only for impotents with arterial lesions. Impotents with severe artery damage, for example stenosis or atherosclerosis, will not recover erection capability with this treatment. Nor will patients with venous incompetence have any benefit because they will not be able to achieve and maintain satisfactory erection.

There remain unresolved problems. For example, how long will the erectile recovery last? And how long should treatment be continued? We will continue the study with a larger group of subjects to clarify these questions.

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和文抄録

勃起の自然回復を期待した陰茎海綿体注射療法

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平滑筋弛緩作用のある塩酸パパベリンなどを陰茎海綿体内に投与することにより人工的勃起が得られる。陰茎海綿体内への自己注射法が欧米を中心に広く行われているが、数回の注射で勃起機能が回復する症例があることに注目し、勃起の自然回復を期待した陰茎海綿体注射療法を試みた。対象とした症例は、来院順に過去に検査目的以外には陰茎海綿体内薬物投与が行われていなく、海綿体内注射で勃起の得られる10人を選

び、週1回連続10週の塩酸パパベリン陰茎海綿体内投与を行った。10例中6例に勃起が回復し、1例を除く5例は1年を経過した現在も性交が可能である。効果のあった症例は、治療前のPenile-Brachial-Indexが低値を示し、治療後は正常値を示す傾向にあった。本療法の作用機序について、勃起のメカニズムから考察した。

（泌尿紀要 35：1145-1148, 1989）