HYPOSPRAY TREATMENT OF TENNIS ELBOW*

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It has long been known that fine jets of oil from diesel engines, travelling at high velocity, may accidentally penetrate the skin without causing pain.

Using this principle, Figge and Scherer (1947) developed an instrument capable of injecting a fine spray of liquid through intact skin to a depth comparable with an intramuscular injection. Since then, this instrument has evolved into the conveniently-sized "Hypospray" which is available for clinical use. Initial reports suggest that this is an effective and safe method of administering subcutaneous, intramuscular, and even certain intra-articular injections (Hingson and Hughes, 1947; Figge and Barnett, 1948; Perkin, Todd, Brown, and Abbott, 1950; Goldman, O'Hara, and Baskett, 1952; Ziff, Contreras, and Schmid, 1956; Towle, 1960; Epstein, 1965; Weller and Linder, 1966; Rankin and Good, 1966). The main advantages of giving injections by this method would seem to be its convenience for administering identical injections to large groups of subjects (as in immunisation programmes) and the elimination of the apprehension and pain associated with conventional needle injections. The latter advantage suggests that the Hypospray may be particularly useful for the local injection treatment of minor rheumatic conditions.

For this reason we have tested the Hypospray in the treatment of tennis elbow, a condition in which conventional injections are sometimes extremely painful to administer. We report here a controlled trial in which local infiltration with hydrocortisone, using the Hypospray is compared with injection by needle. In addition, the trial has enabled us to form some impressions about the general usefulness of this instrument in a routine injection clinic for locomotor disorders. We have also used cadaver material to investigate the tissue penetration achieved by the Hypospray.

Instrument

The Hypospray (Fig. 1) is designed to take a 50-ml. rubber-capped, multidose bottle. Accurate measurement of dosage is possible, but the maximum volume of a single injection is only 1 ml. A cranking action compresses the powerful spring and draws the pre-determined

dose of medicament into a "firing chamber" as the plunger is retracted. Button pressure releases the spring and plunger to force fluid from the chamber out through a fine nozzle. The calibre of the nozzle orifice determines depth of penetration, and the experiments described here were carried out with the "intramuscular" size. Of two mountings available we chose the one providing a pointed rather than a flat tip to the instrument.

The impact pressure of 12,000 lb. per sq. in. lasts for 1/1000th of a second, and is followed by a more sustained pressure of 2,725 lb. per sq. in. These achieve respectively penetration of the skin and dispersion of the medicament. Figge and Barnett (1948) have shown that superficial veins are not entered provided that the instrument is applied firmly to the skin. Firm pressure of the nozzle against the skin is anyhow essential for the safe and effective firing of the instrument.

Aqueous solutions, oils, colloidal suspensions, and emulsions have been injected with the instrument. In our experience, however, the instrument is impracticable for thick gels such as ACTH.

Design of Trial

Fifty consecutive patients diagnosed as suffering from tennis elbow, in whom there was no evidence of either cervical spondylosis or inflammatory arthropathy, were randomly allocated to receive either needle or Hypospray injection. Needle injection consisted of 25 mg. (1 ml.) hydrocortisone acetate mixed with 1 ml. 2 per cent. lignocaine solution. The Hypospray could not have delivered this volume of liquid, and pre-mixing would have been impracticable, so Hypospray injections consisted of 25 mg. hydrocortisone acetate alone. Thus, we have compared, on the one hand, what we regard as optimal needle treatment with, on the other hand, what is possible and practicable using the Hypospray. All injections were given into the site of maximum tenderness in the region of the lateral epicondyle.

Patients were assessed before injection and again, 2 and 8 weeks later. At each visit the degree of spontaneous pain and tenderness on pressure was assessed. At the appropriate visits patients were questioned about pain produced by the actual injection, and overall results were assessed as "success", "doubtful", or "failure".

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Fig. 1.—The instrument in place for treating the elbow joint.

If at 2 weeks, the result was unsatisfactory, a second injection was given, using the same method as before. In the few patients receiving third and fourth injections, these were given by the method not used initially.

Results

Number of Patients: 50. Follow-up at 2 weeks: 100 per cent.

Total Number of Injections: 74 (Hypospray 40; Needle 34).

Patient Success Rate:

SUCCESSFUL AT FIRST INJECTION—32 (64 per cent.)

Hypospray 18 out of 28 (64 per cent.);

Needle 14 out of 22 (64 per cent.).

UNSUCCESSFUL AT FIRST INJECTION—18 (36 per cent.).

Of these, 14 received two injections, 2 received three injections, 2 received four injections; thus, of the total of 50 patients, 48 (96 per cent.) were cured by three injections.

Overall Injection Success Rate (2-week assessment):

Method	Success	Doubtful	Failure	Total
Hypospray	23 (58%)	9 (22%)	8 (20%)	40
Needle	20 (59%)	4 (12%)	10 (29%)	34

Pain of Injection

Method	Nil	Slight	Moderate	Severe	Total
Hypospray	17 (42%)	16 (40%)	3 (8%)	4 (10%)	40
Needle	3 (9%)	11 (33%)	10 (29%)	10 (29%)	34

Relevance of a Previous History of Tennis Elbow.—

Of the 32 patients cured at the first injection, five (16 per cent.) had had a previous episode of tennis elbow. Of the eighteen who needed more than one injection, six (33 per cent.) had had previous tennis elbow.

Handedness.—In 33 of the fifty patients (66 per cent.) the dominant side was affected. Dominance had no bearing however on the outcome following treatment.

Patient Preference.—Of the nine patients who needed three or four injections, and therefore experienced both methods of treatment, all preferred the Hypospray.

The success rate for initial injections was 64 per cent and 48 of the fifty patients (96 per cent.) were cured by three injections. There was no significant difference in effectiveness between the two methods. By contrast, there was an impressive difference in the immediate pain provoked by the actual injection. Four patients did complain of "severe" pain during the Hypospray injection, but in all of these the pain was due to pressure of the nozzle against the tender site before the material was injected. Actual firing of the instrument was not itself painful. An equally impressive advantage for the Hypospray was the avoidance of apprehension which the needle provoked in some subjects. This is not reflected directly in the data, except that all six patients receiving both methods of treatment had a strong preference for the Hypospray. One patient treated by needle developed a severe reaction with urticaria and glottic oedema—presumably due to lignocaine sensitivity.

Compared with a hypodermic syringe, the instrument was simpler and quicker to operate—once it had been prepared for use. However, the preliminary routine was somewhat complicated, and the autoclaving procedure between clinics required care. Occasional more elaborate cleaning and lubricating overhauls are necessary. During the 3 months that the trial was in progress the instrument had to be returned to the makers on two occasions for minor repairs.

The findings confirm the widely-held view that tennis elbow is more common in the dominant hand. It was also noted that the chances of success were less in those with a past history of tennis elbow and in those who had received a previous (unsuccessful) injection for the present attack.

Follow-up of the two patients not helped by four injections revealed that both were still afflicted. One, a 45-year-old crane driver stated that he had had twelve injections in various hospitals before finally coming to surgery. At operation no anatomical abnormality was found. He is now returning to work after being off for 9 months.

The second patient is still in pain but has not yet come to surgery—her other arm was explored for tennis elbow 2 years previously.

Cadaver Studies

The same instrument used in the clinical study (fitted with the "intramuscular" nozzle) was loaded with a dye solution for injection into cadavers.

Injection into the thigh resulted in the bulk of the dye solution penetrating to a depth of between 2.5 and 3.5 cm. There was a tendency for the fluid to track laterally along tissue planes running parallel with the skin (Fig. 2). Varying the local temperature did not alter the depth of penetration.

Fig. 2.—Injection into the thigh showing:

- (1) Entry (high pressure) track;
- (2) Tendency for lateral tracking at the deep fascia before muscle penetration. Very little material was, however, lost at this point.

Injection over the lateral epicondyle, as in the treatment of tennis elbow, resulted in the dye penetrating not only the fibres of the common exterior origin, but also into the actual periosteum (Fig. 3, opposite).

Discussion

These studies confirm the mechanical efficiency of the Hypospray in injecting liquids to a depth comparable with an intramuscular injection given by needle. In the treatment of tennis elbow it provides an alternative technique which has the same modest success rate, but in which the pain of injection is much less than with a needle. This, and the elimination of the cause of apprehension in

Fig. 3.—Lateral epicondyle dissected after injection with pospray.

- (1) Fibres of origin of common extensor with indian ink dispersed among them.
- (2) Periosteum (below) slit to show ink between periosteum and bone.

needle-shy subjects, makes it a very much more acceptable form of treatment from the patient's point of view.

The instrument has also been used to treat other conditions seen in the injection clinic. The simplicity and effectiveness of injecting multiple arthritic finger joints reported by Baum and Ziff (1967) has been confirmed. It is particularly valuable in this situation, where needle injections are seldom practicable. Painful shoulders and heels have also been treated. Here again the injection is much less painful than by needle, and the success rate probably comparable. In general, injection clinics using the Hypospray are simpler and more relaxed for the staff and less traumatic for the patients.

The sterile precautions suggested by the manufacturers were followed and we have no reason to suspect that they are not adequate, nor do we doubt their claim that there is little or no risk of transmitting viral jaundice from patient to patient.

The important question is the value of this instrument in the treatment of locomotor disorders. Against its obvious advantages must be set the high initial cost and a somewhat elaborate maintenance routine. It is a precision instrument which requires careful handling. The design of this model limits the volume of individual injections to a maximum of 1 ml., and only rubber-capped, multi-dose vials of certain size can be used. This lack of flexibility means that the instrument finds its main application in the administration of repetitive, identical injections

as, for example, in immunization programmes. Our experience suggests that the Hypospray is probably not sufficiently robust to be kept as a departmental instrument for general use. But where one person can take responsibility for the somewhat meticulous maintenance care necessary, it can certainly make injection clinics far more acceptable to patients. In the case of multiple finger joints it increases materially the scope of injection treatment. When, in addition, sufficient patients suitable for Hypospray treatment can be grouped together in sessions for treatment, there will be a saving in time and efficiency as well. The operating routine means that the Hypospray is inefficient when used for occasional, single injections.

Summary

Fifty patients suffering from tennis elbow were randomly allocated to treatment either by Hypospray injection of hydrocortisone acetate, or by a standard hypodermic injection technique. Success rates were similar (64 per cent. immediate success rate), but the Hypospray was considerably less painful and was more acceptable to patients. Cadaver studies confirmed the effective penetration of suspensions administered by this method.

The Hypospray is a useful, if expensive, instrument for treating minor locomotor disorders. Operating and maintenance routines are somewhat complicated, and require considerable care. The method probably becomes more efficient and quicker

than existing techniques only when patients are grouped for this method of treatment at one session.

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Note: The Hypospray is marketed by R. P. Scherer Ltd., 216 Bath Road, Slough. The present market price to the medical profession is approximately £180.

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Le traitement de l'épicondylalgie par le "Hypospray"

RÉSUMÉ

Cinquante malades atteints d'épicondylalgie ont été choisis au hasard afin d'être traités soit par injection de l'acétate d'hydrocortisone par le "Hypospray" ou par la technique de l'injection hypodermique standard. Les taux de succès sont semblables (64 pour cent, taux de succès immédiat) mais le "Hypospray" était beaucoup moins douloureux et était plus facilement accepté par les malades. Les études faites sur les cadavres ont confirmé la pénétration efficace des suspensions par cette méthode.

Le "Hypospray" est un instrument pratique, quoique coûteux, pour le traitement des affections locomotrices mineures. Le maniement et l'entretien sont plutôt compliqués, et demandent un soin particulier. La méthode probablement devient plus efficace et plus rapide que les techniques courantes seulement quand les malades sont groupés pour une session.

Tratamiento "Hypospray" de la epicondilitis radial humeral

SUMARIO

Cincuenta pacientes que padecían epicondilitis radial humeral fueron elegidos al azar a fin de someterlos a tratamiento por inyección "Hypospray" de acetato de hidrocortisona, o por la técnica standard de inyección hipodérmica. Las tasas de éxito fueron similares (tasas de un 64 por ciento de éxito inmediato), pero el "Hypospray" resultó considerablemente menos doloroso y más aceptable por los pacientes. Los estudios en cadáveres confirmaron la penetración eficaz de suspensiones administradas por este método.

El "Hypospray" es un instrumento útil, aunque costoso, para el tratamiento de afecciones locomotrices menores. Las rutinas de operación y mantenimiento son un tanto complicadas y requieren considerable cuidado. El método se torna quizá más eficaz y más rápido que las técnicas existentes solamente cuando los pacientes son agrupados en una sesión para recibir este tratamiento.