improving. In one there was massive destruction of the hypothalamus and mid-brain which gave rise to diabetes insipidus.

We thank Dr. W. T. Smith and Dr. R. Lannigan for the necropsy reports. This work was in part supported by a grant from the British Diabetic Association.

REFERENCES

- Black, A. B., and Malins, J. M. (1949). *Lancet*, 1, 56.
 Cohen, A. S., Vance, V. K., Runyan, J. W., jun., and Hurwitz, D. (1960). *Ann. intern. Med.*, 52, 55.
 Collen, M. F. (1942). *Arch. intern. Med.*, 70, 347.
 Danowski, T. S. (1957). *Diabetes Mellitus, With Emphasis on Children and Young Adults*. Williams and Wilkins, Baltimore.
 Dillon, E. S., Riggs, H. E., and Dyer, W. W. (1936). *Amer. J. med. Sci.*, 192, 360.
 Greenaway, J. M., and Read, J. (1958). *Aust. Ann. Med.*, 7, 151.
 Harwood, R. (1951). *New Engl. J. Med.*, 245, 1.
 Hudson, B., Bick, M., and Martin, F. I. R. (1960). *Aust. Ann. Med.*, 9, 34.
 Joslin, E. P., Root, H. F., White, P., and Marble, A. (1959). *The Treatment of Diabetes Mellitus*, 10th ed. Kimpton, London.
 ——— and Joslin, A. P. (1937). *Arch. intern. Med.*, 59, 175.
 Kety, S. S., Polis, B. D., Nadler, C. S., and Schmidt, C. F. (1948). *J. clin. Invest.*, 27, 500.
 Nabarro, J. D. N., Spencer, A. G., and Stowers, J. M. (1952). *Lancet*, 1, 983.
 Owens, L. B., and Rockwern, S. S. (1939). *Amer. J. med. Sci.*, 198, 252.
 Rabinowitch, I. M., Fowler, A. F., and Bensley, E. H. (1939). *Ann. intern. Med.*, 12, 1403.
 Skillman, T. G., Wilson, R., and Knowles, H. C., jun. (1958). *Diabetes*, 7, 109.

THE RELIEF OF PAIN BY COOLING OF THE SKIN

BY

MAURICE ELLIS, M.A., M.B., B.Chir., F.R.C.S.
*Consultant Surgeon in Charge of the Casualty Department,
 the General Infirmary at Leeds*

In 1949 Dr. Janet Travell described the use of ethyl chloride spray in the treatment of acute wryneck. In 1951 Dr. W. A. Bain drew my attention to this work and suggested that this form of treatment might be of use in my department. Since that time I have used ethyl chloride in the treatment of so many painful conditions with such success that I should now be loath to run a busy casualty department without its help. In 1952 Travell described the use of the ethyl chloride spray in the treatment of painful muscle spasm giving a full bibliography, and pleaded for a wider trial of this simple therapeutic measure. In 1956 I reported locally my experiences with it (Ellis, 1956). Further advances have been made since then, and I should like to draw attention to the value of this treatment as revealed by nine years' experience of its use in this department, in the hope that others may try it.

Cooling of the skin by spraying with ethyl chloride has been used to treat all kinds of skeletal muscle pain, and also the pain of renal colic, of dysmenorrhoea, of migraine, and of causalgia; Taverner (1960) reports its use in post-herpetic neuralgia. The usual treatment of such conditions is by analgesics, from salicylates up to morphine and pethidine. Such analgesics succeed in dulling the pain to a greater or less extent, whereas the virtue of the spray treatment is that it abolishes the pain. That the pain may recur in some cases is no denigration of its efficacy, for many of these conditions

require repeated doses of analgesics over a prolonged period to afford adequate comfort to the patient.

Types of Pain Relieved

Certain types of pain in which the spray has given dramatic relief are now described in more detail.

Lumbago

This term is used to cover a wide variety of types of low back pain. The acute, severe form presents a reasonably clear-cut clinical entity. The patient is seized with acute pain on getting out of bed in the morning or while bending and lifting a heavy weight. He presents a rigid back, and attempts to move increase the pain. Examination shows complete obliteration of the curve of the normal lumbar lordosis, often with scoliosis. When the patient lies prone on the examination couch the rigid straight back persists.

Treatment of this type of case is probably the most satisfactory use of the spray, for, in addition to relief of the pain, the deformity of the back can be seen to disappear. The lumbar region is vigorously sprayed for some 20 to 30 seconds. During the next few minutes the return of the normal lumbar curve can be seen to take place under the eyes of the surgeon, together with the disappearance of the scoliosis. When the patient turns to lie on his back he will admit that the acute pain has gone, but for some time there is a residual dull ache.

The after-treatment of such cases is usually rest in bed. With the abolition of pain and rigidity the patient can rest in comfort for whatever number of days is considered necessary. Some patients, however, have so much relief that they return to work on the same or the following day. Patients running their own small businesses are particularly grateful for the relief from the crippling pain, as it now allows them to continue at their work.

The more chronic types of low back pain often do not respond so dramatically. Travell has observed this also. But a large number of these cases do obtain such a considerable measure of relief that the spray is recommended as the first line of attack.

Acute Stiff Neck

I have often seen the dramatic sudden relief produced in this type of case, as reported by Travell. The patient who complains of a sudden "crick" in the neck on getting out of bed in the morning, and presents with acutely painful wryneck, is well known. Spray applied to the painful side of the neck brings dramatic relief.

Fibrositis

In the many cases of pain in muscles, in fascia, and around joints that can be lumped under this title, I regard the use of the spray as the first line of attack. Of the hundreds of patients who have attended this department in the last nine years, some have had complete relief after a single application of the spray. Others have had recurrences of pain and have required several sprays over some days. Two cases among my surgical colleagues are noteworthy. Each was afflicted with acute shoulder pain when called in to do emergency operations in the private wing. As a last resort, and without much hope of relief, they asked for the spray treatment. The spray gave them full, painless movement, and they were able to operate without disability.

Painful Scars and Causalgia

The use of spray in this type of pain produces relief where analgesics have failed to do so. In painful amputation stumps, spray treatment can be used either to replace or to complement percussion.

Renal Colic

The value of the spray treatment in relieving the agony of renal colic was, so far as we know, discovered in this department, in which we see some 30 to 40 cases a year. Renal colic is usually treated with large doses of morphine or pethidine, often with atropine or propantheline. Such treatment rarely brings immediate relief of pain. But the cold spray, applied from the renal angle down to the pubes, gives immediate relief from the colic. In many cases the general practitioner had given repeated doses of analgesics and finally sent the patient to me for admission. After being sprayed the patients said they were free from pain for the first time. I am now so sure that immediate relief follows spray treatment that recently, when a patient claimed no relief after three vigorous sprays and begged for an injection, I suspected that he was a pethidine addict. This suspicion was subsequently confirmed.

The cause of renal colic is usually a stone—and improved radiological techniques in our urology department now demonstrate the calculus in an ever-increasing number of cases. Colic may recur as the stone passes down the ureter, but these further episodes of colic will also respond to the spray. One patient visited me five times in four days for repetition of the spray, and after the fifth treatment the calculus was passed. It is my practice to refer patients to the next urological clinic for investigation and any necessary surgical treatment. In a large number of cases surgical intervention is now unnecessary, and the spray is used to treat any attacks of pain while the calculus is being passed *per vias naturales*.

Dysmenorrhoea

The use of a cold spray in this condition was evidently rediscovered in this department, for one case had previously been reported (Gardner, 1951). We see yearly some 25 to 30 young women who are brought in on a stretcher, "rolling in pain," sweating, and with a greenish pallor. A spray to the hypogastrium for 15 to 20 seconds gives instant relief. Within 10 minutes the patient walks out, with a normal colour and free from pain. Some of our own female staff have sought treatment, but many are too shy to come to a male doctor with this personal feminine complaint. Some of these young ladies treat themselves with the spray. One of my colleagues reported the incident of a nurse in the operating theatre who was almost disabled and fainting with the pain and was sent out to rest. She took a bottle of ethyl chloride out with her and returned five minutes later completely recovered, and continued her work for the rest of the morning without trouble.

The effect of the spray in renal colic and dysmenorrhoea is of great interest in consideration of the rationale of the treatment.

One further type of case of interest in this context is the fractured rib.

The Fractured Rib

We have learnt by experience that in the first few days after a fractured rib, although the spray does relieve the pain, the relief is so temporary that it is unwise to

use it. While there is acute local tenderness at the site of the fracture, it is our practice to infiltrate carefully with procaine. After two to four injections the acute local tenderness disappears and a residual aching pain is left. At this stage the spray will produce relief lasting 24 hours and, later, for longer periods. The spray treatment is used for many types of post-traumatic pain of this nature with striking relief.

Rationale of Treatment

I am at one with Travell in thinking that the local anaesthetic action of freezing by cold plays no part whatever in the mechanism of relief. I agree that the spraying should not be prolonged so that freezing occurs. Travell goes into some detail on the importance of trigger points in the fascia or muscles in the mechanism and suggests that the spray acts on these points. Trigger points in fascia or muscles can hardly be incriminated in the production of the pain of renal colic or dysmenorrhoea. The theory is put forward that the spray acts by bombarding the central pain receptor areas with such a barrage of cold impulses that the pain impulses are swamped and obliterated. When the sensation of pain is obliterated the reflex arc is broken and the motor impulses causing muscle spasm stop. The muscle will relax. In renal colic the stone moves a little down the ureter. In spasmodic dysmenorrhoea the uterus relaxes, and a clot causing irritation can move away from the irritated area. In these types of case, when the barrage of cold impulses ceases there is no longer any source of irritation, and so no reflexes are set up and there is consequently no muscle spasm and no pain.

In the prolapsed-disk type of lumbago that I have described, similar relaxation of muscles occurs—they are seen to relax—and the prolapsed nucleus is no longer being squeezed out. With the absence of pressure this herniated mass ceases to press on the adjacent nerves and there is no cause for further pain when the cold wears off. Relaxation of skeletal muscles can be postulated to occur with disappearance of pain. In conditions like post-herpetic neuralgia and migraine a pain reflex mechanism has been set up which the barrage of cold impulses breaks. From the observed results in the treatment of fractured rib it is seen that the barrage of cold impulses obliterates the pain temporarily. But when the barrage ceases the cause of the pain is still present and unchanged and pain recurs. Later the cause of the pain in the rib is healing over, the spray breaks the pain reflex and relieves pain for much longer. The treatment, in fact, can be said to be vigorous counter-irritation.

Technique of Treatment

Although the rationale suggested is mere physiological speculation by a surgeon, producing a theory to account for the results, it indicates what is required in carrying out treatment by the spray. Since we wish the skin to remain sensitive to cold, we should not attempt to freeze it and render it anaesthetic. The pack of ethyl chloride put out by the makers for producing local anaesthesia ejects a very fine jet of liquid ethyl chloride on to the skin; this evaporates, extracting its latent heat of evaporation from the skin and freezes it. The use of this type of pack results in many failures, as would be expected from the hypothesis suggested.

What is required is a long nozzle of somewhat larger diameter which ejects the ethyl chloride in a fine spray,

the drops of which are already evaporating and are cold on reaching the skin. (Hedley No. 13 pack for general anaesthetics is the most suitable of those commercially available.) It follows that the nozzle should be held far enough away from the skin to allow the fluid to break up into cold droplets and not so far away as to produce only an attenuated blast of cold gas. With this pack 12 to 18 in. (30 to 45 cm.) is found to be a suitable distance. If these rather simple directions are borne in mind the rather elaborate technique recommended by Travell will be found to be unnecessary. The length of time the spray should be continued varies a little with the severity of the pain. The spray should not be so prolonged that skin-freezing occurs, and should be stopped at the earliest suggestion of freezing. To continue longer will produce no effect on anaesthetized skin, in addition to which a cold burn may result. Some of my colleagues find several repeated bouts of five seconds produce the required result. To obtain the mass barrage required, all the skin of the appropriate dermatome should be sprayed. In renal colic, lumbago, and dysmenorrhoea, to keep up the attack, the spray can be continued for 15 to 30 seconds, using about one-half to three-quarters of the bottle, before any sign of freezing appears.

Treatment by the spray is simple; the technique can be easily learnt and carried out by the general practitioner in the house or by co-operative lay persons. Many local general practitioners are using it with gratifying results. To give the ethyl chloride bottle to the patient for personal use in the home is not, however, without danger. Ethyl chloride is flammable, toxic, and anaesthetic. To get over these disadvantages, Dr. Travell and, later, Smith Kline and French Laboratories in Philadelphia experimented with inert liquids of low boiling-point so as to discover one with the same physical properties as ethyl chloride. Dr. Bain eventually produced a mixture of fluoromethanes for us, put up in a metal canister similar to that used in household aerosols. If this spray pack ("skefron") is held a little farther away from the skin than ethyl chloride the cold effect on the skin is almost identical and the clinical results are comparable. We have given these canisters to a number of patients experiencing various kinds of pain, for them to take away for home use. One patient with moderately severe low-back pain was relieved by the skefron spray used in this department and asked for help to continue in his newly started business as a painter and decorator. He was given a canister to take home. At the end of a week he returned asking for a further supply. He told us that, although his pain had recurred at intervals, the skefron spray had relieved it so much that he did not have to give up any of his work.

Summary

Some papers recommending the use of ethyl chloride spray in the treatment of acute pain associated with muscle spasm are reviewed.

Nine years' experience in the casualty department of the General Infirmary at Leeds with the ethyl chloride spray for the treatment of acute pain in many conditions is described. These painful conditions include lumbago, acute wryneck, fibrositis, renal colic, dysmenorrhoea, and fractured rib.

A theory is put forward to account for the many striking successes achieved and also to account for the failure in some cases. The technical points necessary

for success are discussed. A new fluoromethane product, skefron, which is non-toxic and non-flammable and gives the same results as ethyl chloride, is described.

I am indebted to Dr. W. A. Bain for his long-continued interest in this treatment. The new product, skefron, was evolved at his suggestion. To Smith Kline and French Laboratories, Philadelphia, I am indebted for liberal supplies of fluoromethane mixtures for clinical trial.

REFERENCES

- Ellis, M. (1956). *Univ. Leeds med. J.*, 5, 160.
Gardner, D. A. (1951). *J. Osteop.*, 58, 19.
Taverner, D. A. (1960). *Lancet*, 2, 671.
Travell, J. (1949). *J. Amer. med. Wom. Ass.*, 4, 89.
— (1952). *Arch. phys. Med.*, 33, 291.

OSTEOSCLEROTIC BONE CHANGES IN PRIMARY HYPERPARATHYROIDISM WITH RENAL FAILURE

BY

M. R. WILLS, M.B., Ch.B.
Registrar in Clinical Pathology

R. E. RICHARDSON, M.R.C.P., D.M.R.D.
Senior Registrar in Radiodiagnosis

AND

R. GORDON PAUL, F.R.C.S., F.R.C.S.Ed.
Consultant Surgeon
United Bristol Hospitals

It is well recognized that primary hyperparathyroidism may cause a serious form of renal disease (Albright *et al.*, 1934; Richardson, 1953). It is also a well-established fact that chronic renal insufficiency may result in secondary hyperplasia of the parathyroid glands (Albright *et al.*, 1937; Castleman and Mallory, 1937; Shelling and Remsen, 1935). Bone changes are sometimes detectable radiologically in these latter patients, and they then resemble closely the changes in primary hyperparathyroidism (Dent and Hodson, 1954; Stanbury, 1957). Osteoclerosis may develop in cases of renal failure, although it is an uncommon radiological finding (Crawford *et al.*, 1954; Karani, 1955; Wolf and Denko, 1958), and the demonstration of osteosclerosis in a patient with hyperparathyroidism has been taken to show that hyperparathyroidism is secondary (Brookfield *et al.*, 1955). However, the renal damage resulting from primary hyperparathyroidism could presumably produce osteosclerosis similar to that seen complicating primary renal disease. A case was reported by Beveridge *et al.* (1959) of a patient with a parathyroid adenoma in whom renal failure was present and radiological examination showed presence of marked osteosclerosis.

We wish to report the case of a patient who we believe had primary hyperparathyroidism, osteosclerotic bone changes, and renal failure. A further unusual feature was that of calcification in a haemorrhagic parathyroid cyst.

Case History

A spinster aged 63 was first seen by one of us (R. G. P.) at the request of Mr. M. P. McCormack, to whom the patient had been referred with a fracture of the right radius. The first symptom possibly attributable to her bone disease had occurred in 1955, when she attended another hospital