SUBARACHNOID ALCOHOL BLOCK IN PARAPLEGIA
ITS BENEFICIAL EFFECT ON MASS REFLEXES AND BLADDER DYSFUNCTION*

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IN VOLUNTARY reflex spasm of the paralyzed muscles is present to some degree with most patients following permanent injury to the spinal cord. The etiology of these powerful muscular contractures remains a mystery. Likewise, the absence of this mass reflex in some patients is equally difficult to explain.

Immediately after injury a period of so-called spinal shock exists, during which the paralysis is of a flaccid character. Some weeks later reflex activity reappears and may progress to marked hyperactivity and involuntary muscular spasms. At times the reflex spasm, evoked by simply touching the skin over the paralyzed area, may be so powerful that it is physically impossible for the examiner to overcome the strength of the muscular contractions.

Why are these mass reflexes so important in the management of the paraplegic patient as to justify the injection of absolute alcohol in large amounts into the subarachnoid space? Every paraplegic patient’s greatest desire is to walk, even though it may be only with the aid of braces and crutches. The mass reflexes serve as a formidable obstacle to this achievement. The patient cannot maintain an erect position even if he is physically able to handle crutches with his arms and shoulders. Flexion deformities are frequent, often with secondary structural contractures. These add to the patient’s discomfort and increase the danger of trophic ulcers. Control of ulcerated areas, much less repair, is impossible if the deformities persist.

Reflex spasm frequently involves the pelvis and abdomen. The urinary problem is increased because of reflex bladder spasm. If a urinal is used, violent spasms may result in more frequent wetting of the bed, thus adding to the patient’s discomforts and the nursing problems. Abdominal spasms are a source of great annoyance to the patient, at times painful, and greatly interfering with his rest and sleep.

Anterior rhizotomy has been used to relieve mass flexion reflexes with excellent results in selected cases.11 The procedure consists in section of the anterior spinal nerve roots from the 10th thoracic through and including the 1st sacral nerve root bilaterally. Thus, the spastic paralysis of a spinal cord lesion is converted into the flaccid paralysis of a lower motor neuron lesion.

Technically, this procedure is successful in overcoming the disabling...
spasticity, but from the patient’s standpoint the method has much to be
desired. Even though the lesion is known to be complete, the patient still
lives in hope that some return of function will occur, or that science will yet
learn some new method of utilizing the powerful muscular strength being
wasted in reflex contractions. He can hardly be condemned for the latter
idea, as the combination of voluntary paralysis with excessive involuntary
muscular power is difficult for him to accept.

Section of the motor nerve roots does away with all hope of recovery. The
psychic trauma must be great, and this element of the patient’s illness
must not be neglected. If the spinal cord lesion was not anatomically com-
plete at the time of local exploration, no one can honestly assure a patient
within the first 2 or 3 years that some degree of recovery is impossible, even
though experience would make the prospect negligible. Every patient has
heard of someone who has had slight return of function after a long period
of complete paralysis.

From the surgical standpoint, rhizotomy is satisfactory, but identifica-
tion of the proper nerve roots is not as simple as generally considered. Mun-
ro’s concept of the last dentate ligament as a guide to the 1st lumbar nerve
root has not been supported by recent anatomico-surgical studies.4,9

There was a definite need of a simpler method that would achieve the
same result as rhizotomy; in other words, a procedure for paraplegics that
is comparable to alcohol injection for major trigeminal neuralgia.

Subarachnoid alcohol injection fulfills the desired criteria. The method
is simple, requiring only a lumbar puncture. Systemic effects are negligible,
and the relief of spasticity is immediate.

Subarachnoid injection of alcohol has been employed for years for con-
trol of pain, but the amounts used have never been sufficient to control
spasticity except for the recent work of Pudenz and Nourse,14 whose data are
soon to be published.

Selection of patients for alcohol injection was based on the severity of
the mass reflex and the status of their urinary bladder. No patient was con-
sidered a candidate for injection if he had any degree of voluntary bladder
control or if he had developed a reasonably satisfactory type of automatic
bladder function.

All patients injected had a complete paraplegia of both legs of at least
1 year’s duration with no evidence of improvement in their motor function.

Pre-injection studies include a complete check2 of testing the bulboc-
cavernosus reflex, the amount of residual urine, cystoscopic, cystometric,
sphincterometric and cystographic examinations (as part of urographic stud-
ies) with and without spinal anesthesia.* Spinal anesthesia in connection
with these examinations proved to be of value for the future prognosis of
the respective bladder conditions. The importance of cystography in the

* These examinations were carried out by Dr. Stanley H. Moulton. A description of method and
detailed study of results is being prepared.
management of the bladder in paraplegic patients has been stressed in a previous publication. This procedure will detect vesico-ureteral reflux which contraindicates the use of tidal drainage.

TECHNIQUE

The technique of subarachnoid alcohol injection is simple. The patient is placed on his side. No pillow is used under the patient's head, but a large pillow is placed between the knees. The foot of the bed is placed on two chairs so that the maximum elevation of the legs and pelvis is obtained. The injection is made routinely at the interspace between the 1st and 2nd lumbar vertebrae through an 18 gauge spinal puncture needle, but blocks as high as D11-D12 have been used where indicated. Five cc. of cerebrospinal fluid are removed, and 10 to 15 cc. of absolute alcohol are injected slowly. The patient is immediately rolled onto his back and left in this position for 24 hours. Since the alcohol is lighter than the cerebrospinal fluid, the feet of the bed must remain elevated during this 24-hour period.

During injection scattered mild muscular twitching is occasionally observed, but the patient experiences no discomfort. Meningismus and headache were noted a few hours after injection by the first few patients, but this was probably due to an insufficient period of elevation of the foot of the bed.

RESULTS OF ALCOHOL INJECTION

1. Effect on Mass Reflex Spasms. Complete relief of the reflex spasms was obtained immediately in every one of the 24 patients. The first patient was injected 23 July 1946, and he has shown no evidence of return of any spasticity. Only 1 patient has shown any recurrence of muscular spasms, and they are of infrequent occurrence, minimal degree and limited to one leg.

2. Effect on the Bladder. In this series of 24 patients studied, 16 had atonic and 8 hypertonic types of bladder. The atonic bladder presents evidence of an atonic detrusor associated with a spastic pelvic floor including the sphincteric mechanism. This type is characterized by more or less complete retention. In this group of 16 patients, 12 had complete retention and 4 had residual urine varying from 12 to 14 oz. Subsequent to alcohol block 11 patients had voluntary micturition with residual urine amounting to less than 3 oz. The remaining 5 patients showed definite improvement but had residual urine of more than 3 oz. Bladder training as outlined by Munro was of definite value in this latter group of patients and slowly enhanced the beneficial results of alcohol injection.

In this entire atonic group, the bladder capacity after block ranged between 300 and 400 cc., and in a few patients the capacity dropped to less than 300 cc. Only 1 patient in the entire series was not at least partially relieved of his complete retention.

The hypertonic type of bladder is characterized by a small capacity and frequent involuntary emptying, often a spurt of urine with each muscular spasm. There were 8 patients in this group, and all had a bladder capacity of less than 200 cc., the average being between 50 and 100 cc. All 8 patients developed voluntary micturition following subarachnoid alcohol injection, and the bladder capacity usually increased to 300 to 400 cc. At the same
time the ratio of capacity and residual improved. Several patients with 50 cc. capacity and 30 cc. residual prior to block developed a 200 cc. capacity with little or no residual urine. All patients in this group voided satisfactorily with voluntary micturition every 2 hours.

3. Effect on the Bowel. Bowel disturbances after alcohol block were observed on 18 patients. They consisted chiefly of constipation (13 cases) which lasted from 1 1/2 weeks to several months; 3 patients had involuntary movements, and 2 displayed the combination of involuntary movements with alternating constipation. No change of bowel habits was present in 8 patients. It is generally known that training of regulated bowel habits after cord injuries is easier than the training of bladder function. The reason for this observation lies probably with the independent Meissner-Auerbach plexus and also with the physiologic peristaltis whereby the upper intestinal segment initiates impulses to the lower segment. This explains why disturbances after alcohol block responded relatively easily to corrective measures.

4. Effect on Sex Function and Sexual Dreams. It is common practice to attempt relief of patients’ suffering from priapism, due to causes other than cord lesions, by spinal anesthesia. It was therefore not surprising that 22 out of 24 patients lost erections after alcohol block. Two patients reacted differently: 1 did not lose his erections at all, and the other regained them within 4 weeks. Such exceptional response could be explained only by surmising that an individual variety of autonomic innervation existed in the respective cases. Return of semi-erectons, insufficient for sexual relations, was observed in 7 cases. In the entire group of 24 patients there were only 5 who did not have erections prior to block. This is well in line with the rather high incidence of erections in paraplegics. Whereas successful sexual relations were observed in 5 cases before block only 1 patient executed cohabitation after the block.

If one combines the investigations of sex function with a routine exploration of sexual dreams* one encounters a strikingly high incidence of dream changes after alcohol block. Out of 17 patients with sexual dreams before block, 6 underwent dream conversion after block. Five patients lost sexual dreams entirely whereas a 6th patient who had complete sexual dreams prior to block had only incomplete dreams after block. A complete dream consists of realistic sensation with dry orgasm, an incomplete dream lacks orgasm. Nocturnal ejaculations were rare in this series. One such patient lost dreams and nocturnal ejaculations after block. The causes for such dream changes are not as yet known. It is possible that organic factors beside a mental reaction are responsible. In this connection it appears worth mentioning that erections and complete dreams with ejaculations were lost in 1 case subsequent to an anterior rhizotomy which was probably carried too far.

* Data on sex function and sexual dreams in paraplegics are being prepared for publication.
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DISCUSSION

Subarachnoid alcohol injection has proven to be a very satisfactory method for control of mass reflexes. After the spasticity has been eliminated, structural contractures can often be overcome by extensive physiotherapy. Pain has been relieved in a few of the patients, although it was not a major complaint with any of those selected for injection.

The duration of the beneficial effect cannot be determined at this time. It is possible that if spasticity should return the procedure could be repeated with equally satisfactory results. After a few years the factors causing the spasticity may burn themselves out and no further procedure be necessary. The great advantage of alcohol over rhizotomy is immediate complete relief obtained without a major surgical procedure or the sacrifice of any nerve roots.

In analyzing the favorable cases of both groups one common sign becomes conspicuous: the response of the bladder, though isolated from the impulses of the spinal cord by alcohol block, to extrinsic pressure. Although cystometric readings indicate hypo- or atonicity, the detrusor-sphincter balance is restored to such a degree that voluntary straining will suffice to overcome the low opposing force of the sphincteric tissues. This factor can be demonstrated during the pre-injection tests with spinal anesthesia. It almost appears as if the cord exercises a similar inhibitory effect on the system of the regional bladder plexus as the brain in turn does on the cord. Prior to block or spinal anesthesia the lack of coordination and balance between detrusor and sphincter is so obvious in hypertonicity of the bladder, comparable to the hyperactive knee jerk after cord lesion, that even this increased force of emptying is helpless against the spastic sphincters. Only where hypertrophy of the detrusor is combined with true structural hypertrophy of the sphincter do we think that transurethral resection of the obstruction is indicated. This should always be preceded by neurosurgical means to remove bladder hypertonicity, comparable to the accepted orthopedic rule of performing plastic tenotomies for structural contractures only in the presence of flaccidity.

Huggins and his associates have demonstrated that response to the extrinsic pressure of straining can be restored by presacral sympathectomy. His studies were not made on paraplegic bladders. Restoration of balance can also be achieved temporarily or permanently by pudendal nerve novocain blocks. The experience of Huggins and his associates seems to confirm the old theory that the sympathetics participate in the motor innervation of the internal sphincter and the inhibition of the detrusor. Failures of presacral neurectomy have been ascribed by Simons to the incomplete removal of this nerve, due to fibres that are supplied by the 1st (?), 2nd and 3rd sacral ganglion directly to the hypogastric ganglia. The same author postulated some autonomic supply which travels via pudendal nerve to the external sphincter. In addition to that it seems likely that even a motor supply to the
detrusor can be proven in some cases in which cystograms taken before and after pudendal block reveal relaxation of the bladder with increased capacity.* The nature of this nerve supply is not yet clear. There also may be an individual variety of the autonomies. Parasympathetic impulses travel by way of internal pudendal nerves in the act of ejaculation. It is not impossible that such fibres do not stop in the sexual area but also extend farther, i.e., detrusor of the bladder.

Whatever the anatomical supply might be, the fact remains that a bladder that has been entirely isolated from the outflow of L-1 or even D-12 down is not necessarily condemned to become worthless, as claimed by Munro. In contrast to the same author, it has been observed that bladders after alcohol block still respond to his program of bladder training with one restriction: no reflex-emptying will occur on pinching the groin or striking the thigh. This reflex, although not observed by Nourse and Bumpus, is present in a fair number of patients with paraplegia. Its disappearance after alcohol block is not surprising in the light of Munro’s explanation that it is based upon an intact afferent reflex arc in the posterior roots and disappears after interruption of those roots by either posterior rhizotomy or alcohol injection as demonstrated in our cases. After alcohol block the pelvic musculature is relaxed, which is in concurrence with Rose’s theory and should facilitate micturition. The second postulate of his theory, namely fixation of the bulbous urethrae by the bulbocavernosus muscles, is not fulfilled.

The major unsolved problem with regard to the bladder is the etiology of the atonic and hypertonic reaction of the detrusor muscle. It is difficult to understand in a group of paraplegic patients, all of whom have some type of spinal cord injury with mass reflexes, hypertonic sphincter mechanism and the increased deep tendon reflexes, why some should have an atonic and others a hypertonic detrusor muscle. All patients in this group had either cervical or thoracic lesions, but there seems to be no correlation of the bladder findings with the level or degree of completeness of the cord lesion.

Subarachnoid alcohol injection is not intended to supplant surgical rhizotomy, as each procedure has its definite indication. Rhizotomy should be done in those individuals with severe mass reflexes who possess a satisfactory type of bladder and sexual function. In these individuals surgical resection of the anterior roots through S-1 will relieve the spasticity without loss of sexual function, but does not as a rule improve the bladder function unless the root section is accidentally carried low enough to sever the 2nd and 3rd sacral roots. It has been demonstrated (Shelden and Thompson) by direct stimulation experiments that the 3rd sacral root is chiefly responsible for contraction of the sphincteric mechanism. The function of this root has been further demonstrated by local sacral injection and pudendal nerve injection. Cystograms reveal relaxation of the sphincter with both procedures.3

* As yet unpublished data.
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If these sacral roots are severed surgically, nothing is gained that could not be equally well accomplished by alcohol injection.

Subarachnoid alcohol injection should be reserved for those patients with incapacitating mass reflexes who have atonic bladders with excessive residual urine or hypertonic bladders with small capacity and frequent voiding. The sexual capacity should be seriously considered. No patient with satisfactory erections should be injected unless the probable loss of sex function would be compensated by the establishment of voluntary micturition.

SUMMARY

Intrathecal injection of absolute alcohol has immediately relieved the spasticity and mass reflexes in a series of 24 patients with spinal cord injuries. Improved bladder function occurred in patients with atonic and hypertonic detrusor muscles. A voluntary type of micturition was established in 19 of the 24 patients. The longest period of observation after injection has been 15 months, during which time there has been no return of spasticity or mass reflex and the beneficial effects on the bladder have been maintained.

REFERENCES

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