Late results of bulbar trigeminal tractotomy

Some remarks on recovery of sensibility

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SUMMARY Re-examination of eight patients in whom bulbar trigeminal tractotomy had been performed 13 to 15 years previously showed that four had no complaints, and the other four had only very slight complaints about pain. In two patients a Spiller-Frazier operation had been performed after tractotomy, in two patients exaeresis of the infraorbital or supraorbital nerve had been done. As bulbar trigeminal tractotomy is a major operation and the risk of recurrence is substantial, the indications for this type of operation have to remain very restricted. Theories to explain the recovery of sensation are discussed. It is possible that regeneration of transected fibres is responsible for the loss of analgesia.

It has long been known that lesions of the descending trigeminal tract, the fibres of which are mostly thin, interfere with the conduction of pain and temperature impulses from the face. On this basis Sjöqvist (1938) introduced severing the spinal trigeminal tract at the level of the obex as a treatment for trigeminal neuralgia. Though the theoretical basis of this operation seemed plausible, the results were often unsatisfactory and today there are only a few indications for it. This operation was performed in the neurosurgical department (Dr. S. A. de Lange, neurosurgeon) of the former Westersiekenhuis in about 25 patients during the years 1953 to 1957. In these patients the spinal trigeminal tract was incised at the level of the obex. Eight of them could be traced for re-examination in the years 1968 to 1969. The majority of the patients had died in the intervening years, as most of them were elderly people or patients on whom this operation had been done for carcinoma of the maxillary sinus.

The Table summarizes the data of these patients and the findings on re-examination.

COMMENT

In five of these eight cases the corneal reflexes were equal; in one case the corneal reflex was clearly diminished, in two other cases the corneal reflex was slightly diminished on the operated side. It is difficult to assess the disturbances of sensation, as in several of these patients other procedures to

relieve the pain had been performed before and after the tractotomy. It became clear, however, that the disturbances of pain sensation were most pronounced, whereas the temperature sense was less disturbed. This is in accordance with the findings of Weinberger and Grant (1942). It is assumed that conduction of thermal impulses is related to a more rostral part of the spinal trigeminal tract than that of pain (Smyth, 1939). Touch was less affected than the sense of pain, but more than the sensation for temperature. In cases 1 and 4, where there were no complaints of pain, the sensation of the face was perfectly normal. It must, however, be noted that a short time after the operation the sensation of the face was only slightly diminished. In these cases relief of pain had no relation to the degree of postoperative analgesia. The same holds true for Kirschner's electrocoagulation of the Gasserian ganglion.

Persistence of trigeminal neuralgia with complete facial anaesthesia has been noted (Dereymaeker, Dieu, and Spitaels, 1954; Klar, 1960), but relief of pain with only a slight hypaesthesia of the face has been seen as well (Thiry, 1962). Up till now there is no valid explanation for the success of tractotomy. From neurophysiological studies (Darian-Smith, 1970) it appears that groups of neurones in the main sensory nucleus and in all the subdivisions of the spinal nucleus respond to tactile stimuli—for example, bending hairs. In the spinal nucleus the incoming impulses are differently coded in the oral and caudal part and they both have different

ascending projections and endings. One may speculate that these differences in coding and transmission are somehow connected with our perception of 'modalities' of sensation.

Recovery of pain sensation after tractotomy has been observed in a few patients by White and Sweet (1969), but it is more often seen after anterolateral cordotomy. To explain this late return of pain sensation there are two possibilities: (1) a take-over of pain conduction by other fibre systems than the spinal trigeminal or anterolateral tract, (2) regeneration of axons in the transected tract.

A large number of trigeminal root fibres divide into an ascending branch entering the main sensory nucleus upon entering the pons, whereas the descending branch bends caudad to form the spinal trigeminal tract (Windle, 1926; Ramón y Cajal, 1952; Brodal, 1969). If the main sensory nucleus is responsible for the conduction of touch impulses, it is conceivable that recovery of sensation implies a reinstallation of conduction. Collaterals of these ascending fibres terminate in the rostral part of the substantia gelatinosa. A take-over of conduction of pain and temperature impulses by other fibre systems might be possible from an anatomical point of view. In the spinal cord loss of analgesia is seen more often after unilateral than after bilateral cordotomy (Foerster and Gagel, 1932). In unilateral cordotomy recovery of the pain sensation may be due to ipsilateral axons ascending in the homolateral spinothalamic tract. Electric stimulation of the exposed anterolateral column evoked ipsilateral sensations in 12% of the patients examined and bilateral sensations in 6% (White and Sweet, 1969).

However, recovery of pain sensation, though less complete, has also been observed in bilateral cordotomy. According to Foerster and Gagel (1932), other fibre systems of the spinal cord—for example, the posterior columns—may conduct pain sensations. In Noordenbos's view (1959, 1962) recurrence of pain after anterolateral cordotomy is due to a relay of impulses via a slowly conducting, multisynaptic afferent system in the spinal cord, no longer inhibited by the severed fast fibres of the anterolateral tract. There exists ample experimental evidence that pain impulses may travel via fibres which cross and recross in the spinal cord (Karplus and Kreidl, 1925).

With regard to the second possibility, regeneration in the central nervous system—for example, the spinal cord—has been demonstrated in lower vertebrates and in some mammals. In man, however, the possibility of regeneration remains controversial. The presence of bundles of myelinated fibres in the spinal cords of patients with a chronic cord disease—for example, syringomyelia, tabes dorsalis, and cord

compression—has long been known. These so-called aberrant nerve fibre bundles are considered to be a sign of regeneration by many authors. Druckman and Mair (1953) saw these in the spinal cord of patients with compression by a cervical disc, by a myeloma, and in syringomyelia. Stenvers (1959) observed these fibres in a case of chronic diabetic 'myelopathy' caused by thrombosis of the anterior spinal artery. Hughes and Brownell (1963) saw these aberrant nerve fibres in nine cases of chronic spinal cord disease. In their opinion, they arise from posterior roots and are proliferations of severed axons. According to these authors, this proliferation has no useful purpose, the more so as there was no evidence of regeneration of long intraspinal nerve fibres. Aberrant nerve fibres could be produced by experimental compression of the spinal cord in rats and kittens (Duncan, 1955).

Recurrence of trigeminal neuralgia after tractotomy is in Kunc's opinion (1970) due to incomplete section of this tract and not to regeneration of nerve fibres. After severing the spinal trigeminal tract in ten cats, 'several aberrant regenerating fibres of apparently no functional importance were discovered' in one only. In this connection the following observation may be relevant.

CASE REPORT

Mr. T.K., born 12 March 1911, was admitted to the St. Elisabeth Hospital on Curaçao on 3 March 1967, on account of a tumour of the base of the skull on the right side, causing intractable pain. On 11 April trigeminal tractotomy was performed (Dr. M. de Grood, neurosurgeon); the right spinal tract was incised to a depth of 4 mm, and the posterior roots of C2 and C3 spinal nerves were sectioned on the same side. After the operation there was an analgesia of the right side of the face and in the dermatomes C2 and C3 on the right. Furthermore, the left arm and left leg were analgesic, whereas touch was normal. During the following months the patient was free of pain and he died eight months after the operation. In this period the area of analgesia remained unchanged. Microscopy of the medulla oblongata revealed the necrotic area of the spinal trigeminal tract on the right side in which some isolated bundles of nerve fibres could be seen (Figs. 1 and 2). They were very suggestive of regenerated fibres.

As the Gasserian ganglion may be considered as the homologue of a spinal ganglion, it is quite conceivable that the isolated bundles of nerve fibres arise from severed axons in accordance with the view of Hughes and Brownell (1963). Recovery of sensation after tractotomy was not seen by Kunc (1970). This is contrary to our cases 1 and 4, though in these cases the disturbances of sensation after operation were only slight. None of these patients

TABLE
CLINICAL DATA

Name, birth-date, sex	Date of operation	Area of pain before operation	Date of re-examination	Area of diminished sensation on re-examination	Corneal reflex
J.v.E. 3 Aug. 1906 M	25 June 1954	2nd trig. branch on R side	25 Nov. 1968	Normal sensation on right side, diminished sensation in part 2nd trig. branch L	Positive, equal
D.K. 16 June 1900 M	6 June 1955	3rd trig. branch on L side	12 Nov. 1968	Part of 3rd trig. branch on L side	Positive, equal
A.v.B. 24 June 1900 M	11 June 1956	All trig. branches on R side	15 Oct. 1968	All trig. branches on R side	Positive, somewhat lowered on R side
S.S.-P. 7 Feb. 1906 F	4 April 1957	2nd trig. branch on L side	15 Oct. 1968	Normal sensation	Positive, on L side somewhat lowered
J.v.Z.-v.d.L. 4 Jan. 1904 F	9 July 1954	2nd trig. branch on R side	2 Oct. 1968	All trig. branches on R side	Positive, equal
A.J.v.d.H. 2 July 1893 F	12 Nov. 1956	1st trig. branch on L side	2 Oct. 1968	All trig. branches on L side	Positive, on L side somewhat lowered
J.V. 3 Aug. 1902 M	19 Mar. 1956	2nd trig. branch on R side	22 Oct. 1968	2nd and 3rd trig. branches on R side	Positive, equal
M.v.d.S.-K. 25 June 1901 F	6 Nov. 1953	2nd trig. branch on R side	8 Jan. 1969	All trig. branches on R side	Positive, equal

complained about paraesthesia in the face, often an annoying complaint after a Sjöqvist operation. In four of these patients tractotomy was not sufficient to relieve the pain and other operations had to be performed. In cases 2 and 6, exauresis of the infra-orbital and supraorbital nerve was performed, which points to the fact that the peripheral component plays an important rôle in the occurrence of trigeminal neuralgia. In cases 7 and 8 there was a recurrence of pain some years after the tractotomy; these patients were successfully treated with a Spiller-Frazier operation. From the literature it appears that a relapse of trigeminal neuralgia after a Sjöqvist operation is not at all rare (White and Sweet, 1955). Furthermore, the risk of this type of operation in elderly people is greater, which makes indications for this treatment rather restricted. The introduction of carbamazepine and phenytoin in

the treatment of trigeminal neuralgia has greatly reduced the number of operations for this disease.

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TABLE (continued)

CLINICAL DATA

Disturbances of sensation						Complaints on re-examination	Neurosurgical operations before and after tractotomy	Remarks and comment
touch		pain		temp.				
subj.	obj.	subj.	obj.	subj.	obj.			
—	—	—	—	—	—	No pain on R side; for 1½ yrs. pain on L side of face	None	Subjective hypo-aesthesia and hypo-algesia in L infra-orbital area. Temperature sense normal
—	—	+	+	—	—	None	In 1964 exaíresis L infra-orbital nerve (pain L cheek)	Also strongly diminished pain sensation L half of tongue and of mucosa L lower jaw. Touch and temperature sense normal
+	+	+	+	+	—	None	From 1952-56 3 times Kirschner coagulation of right Gasserian ganglion, once exaíresis R infra-orbital nerve	Touch sensation diminished in 2nd and 3rd trig. branch on right side. Pain diminished in area 1st branch. Temp. sensation slightly diminished in area 2nd and 3rd trig. branch
—	—	—	—	—	—	None	Kirschner coagulation of right Gasserian ganglion on 18 Feb. 1957	Normal sensation
—	—	+	+	—	—	Since 1955 slight attacks of pain R side face, controlled by carbamazepine	Spiller-Frazier operation on right side on 26 Feb. 1952	Dissociated disturbances of sensation in area of 2nd and 3rd trig. branches on right side, pain sensation diminished, touch and temp. normal
—	—	+	—	+	—	Slight pain	Shortly before tractotomy twice Kirschner coagulation of left Gasserian ganglion, exaíresis left supra-orbital nerve 1963	Dissociated disturbances of sensation of L half of face, especially in area of 3rd trig. branch
+	—	+	+	—	—	None	Before tractotomy, exaíresis right infra-orbital nerve + Kirschner coagulation right Gasserian ganglion. In 1963 right Spiller-Frazier op.	Strongly diminished sensation of pain 2nd trigeminal branch on R side and of R half of tongue. Pain sensation normal in cutaneous area 3rd trig. branch
+	+	+	—	+	—	Slight pain	Bef. tract. alcohol inject. 2nd trig. br. + Kirschner coag. R Gass. ganglion. After tractotomy exaíresis R infra-orb. nerve, Kirschner, Spiller-Frazier op. R side	Diminished sensation for all modalities in 2nd and 3rd trig. branches on R side. No dissociation

— = normal sensation + = diminished sensation

FIG. 1 Necrotic area of severed descending trigeminal tract in which nerve fibres can be seen. H and E, $\times 54$.

FIG. 2 Higher magnification of nerve fibres shown in Fig. 1. H and E, $\times 140$.

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