SUMMARY

In the literature radiofrequency (RF)-sympathectomy, percutaneous facet denervation (PFD), and percutaneous partial rhizotomy (PPR) have been described already in the seventies and eighties. However, a few years ago, papers have been published on thoracic PFD and PPR showing rather promising long term results. Anatomical considerations, indication, technique, results, and complications of these procedures are briefly discussed. Furthermore, verification studies on PFD and PPR, investigating the reliability of the landmarks used and the anatomical substrate of the procedure are mentioned. In clinical practice general indications and contra-indications of RF-lesioning must be regarded. Despite technical difficulties results of RF-procedures in the thoracic area vary from reasonable to good. These procedures are suitable for symptomatic treatment of several kinds of chronic thoracic pain.

INTRODUCTION

In comparison to radiofrequency lesioning (RF) procedures in the cervical and lumbar area or in to the treatment of trigeminal neuralgia, RF-procedures in the thoracic region have been somewhat underrated. Lower incidence of pain in the thoracic area (compared to the lumbar and cervical region), more intricate anatomical relations, and scarcity of literature are responsible for this phenomenon (Stolker et al. 1993a). However, 3-3.5% of the visitors of a pain clinic suffer from thoracic pain (Brose et al. 1991; Vervest et al. 1993).

Pain in the thoracic area may arise from structures related to the thoracic spine (discs, spinal dura, nerve roots, costovertebral joints, myofascial structures, zygapophyseal joints; Dreyfuss et al 1994). Secondly, thoracic pain may be referred from internal organs in the thorax and upper abdomen (Whitcomb et al. 1995), not only related to inflammatory processes or cancer, but also by metastatic tumors which have developed in vertebral bodies.

Thirdly, iatrogenic sources of thoracic pain by operative procedures, varying from mamma surgery to thoracotomies, must not be overlooked. Especially post-thoracotomy pain is a vexing problem (Kirvelä and Antila 1992). After cancer operations an incidence of up to 11% of chronic post-thoracotomy pain was reported (Keller et al. 1994), more commonly following chest-wall resection and pleurectomy. Finally, thoracic disc herniation may even lead to chronic abdominal pain (Whitcomb et al 1995). Other possible causes of thoracic spinal pain (e.g. degenerative) are discussed elsewhere (Bonica and Sola 1990).
In the majority of these patients the complaints are resistant to conservative measures, such as physical therapy, manual therapy, drug therapy, transcutaneous electric nerve stimulation. These patients may benefit from blockades. It should be emphasized that central and deafferentation pain will not respond to definitive blocks, despite a transient response to local anesthetics (Loeser 1972; Ovelmen-Levitt et al. 1984). In patients with local tumor growth, the possibilities of local blocks are restricted, not only because of simultaneous invasion of several nerve structures, but also because of denervation due to function loss (Stolker et al. 1993b). RF-procedures may have a place in the symptomatic treatment of pain lasting more than 3-6 months (Stolker et al. 1994a).

ANATOMICAL CONSIDERATIONS

The thoracic spine shows the general innervation pattern of the spine. The ventral compartment, constituted by the column of vertebral bodies and intervertebral discs, and by the adjacent structures (anterior and posterior longitudinal ligaments and ventral dura) is supplied by three interlacing nervous networks. These are the nerve plexuses of the anterior (ALL) and posterior (PLL) longitudinal ligaments and a local nerve plexus in the ventral dura. The ALL nerve plexus is formed by direct branches from both sympathetic trunks and is connected to the spinal nerves by the communicating rami, from which the sinuvertebral nerves originate. These nerves build up the PLL nerve plexus and the nerve plexus in the ventral dura. It is important to mention that the innervation of the ventral compartment of the spine is characterized by a multisegmental, bilateral pattern (Groen et al. 1987; 1988; 1990).

The articulatio capitis costae is supplied by the ALL nerve plexus (Groen et al. 1987). In contrast, the dorsal compartment, consisting of the zygapophyseal (facet) joints, costovertebral joints and intrinsic back musculature, receives a unilateral nerve supply of a limited segmental character (Stolker et al. 1994b; Chua and Bogduk 1995). The facet joints are bisegmentally innervated by the medial branches of the dorsal rami, the costovertebral joints by the lateral branches of the dorsal rami (Stolker et al. 1994b; Vrettos and Wyke 1974).

Up to now blocks of the dorsal root ganglion, the medial branch (PFD), and the sympathetic chain have been described. Not only the presence of ribs, but also the vicinity of the pleura is a complicating factor, especially in thoracic PPR and sympathectomy.

PERCUTANEOUS FACET DENERVATION

A PFD is indicated if the following signs and symptoms are present: continuous paravertebral pain, paravertebral tenderness, absence of a neurological deficit and a transient response to a block of the medial branch of the dorsal ramus of the spinal nerve (Stolker et al. 1993a; Dreyfuss et al. 1994). Other signs may be present as well: pain provocation on extension or rotation of the spine, a non-segmental irradiation, and increase of pain after sitting or standing for a longer time. Furthermore, radiological signs have been described, but a strict relation is unclear, like in the lumbar area (Jensen et al. 1994). The technique of the thoracic PFD has been described extensively elsewhere (Stolker et al. 1993a). However, after an anatomical control study the technique had to be adjusted slightly (Stolker et al. 1994b; 1994c).
Furthermore it was established that a thoracic PFD may never lead to a complete denervation, as the co-existing proximal innervation of the facet joints is not within the technical range of the procedure. Two papers published in the seventies were partly dealing with thoracic PFD (Shealy 1976; Lora and Long 1976). They reported a more than 50% pain reduction in 33 and 60% of their patients, using the old 14G Shealy electrodes. More recently 83% of patients experienced a comparable result with a follow-up of up to 4 years. In this study 22G thermocouple electrodes have been used. The difference in outcome may be explained by different patient selection and technique. The only side-effect reported is transient postoperative pain in 12.5% of patients (Stolker et al. 1993a).

PERCUTANEOUS PARTIAL RHIZOTOMY

A PPR is indicated in patient suffering segmental pain with absence of sensible loss. Furthermore, a transient response to a selective block with local anesthetics is imperative (Stolker et al. 1994a). The indication of thoracic PPR is not restricted to pain of spinal origin only. The technique of PPR has been described first by Uematsu et al. (1974) and was modified by Sluijter and Mehta (1981), using 22G electrodes. In the upper thoracic area (T1-8) this lateral approach is dangerous because of the risk of a pneumothorax. Therefore, a dorsal approach using a drill hole with a Kirschner wire has been developed (for description of the technique see Stolker et al. 1994d). The target structure is the dorsal root ganglion and not the root itself (Sluijter and Mehta 1981). It is important to stress that a PPR is a partial lesion, avoiding deafferentation (Van Kleef et al. 1993; Stolker et al. 1994d; 1994e; 1996). In an anatomical control study the technique has been found to be reliable (Stolker et al. 1994e). In the anatomical study the facet joint has been pierced in 25% of cases. However, in the clinical study no clinical relevance of this piercing was demonstrated (Stolker et al. 1994d). Results of the two most recent studies published in the literature are somewhat different due to patient selection (78% more than 50% pain reduction versus, respectively, 37%). In the latest study patient were scored after treatment at one level only even when test blocks showed a bisegmental pain conductance (Van Kleef et al. 1995). In the other study these patients were treated at two levels (Stolker et al. 1994d). The only side effect described in these papers is postoperative pain, although in older studies spinal cord lesions have been reported (Verdie and Lazorthes 1982; Koning et al. 1991). However, these serious complications should be regarded as the result of technical failure, as discussed elsewhere (Stolker et al. 1994a; 1994d).

PERCUTANEOUS SYMPATHECTOMY

Theoretically, a percutaneous sympathectomy may be helpful in the treatment of pain deriving from the anterior part of the spine, in analogy to the lumbar and cervical region. However, this indication seems to be of low incidence in the thoracic spine. The technique have been described earlier by Wilkinson (1984). Reports on its application for thoracic spinal pain are lacking. The procedure has been used in the treatment of complex regional pain syndrome type I and II, and arterial insufficiency of the upper limb. Because of the risk of pneumothorax the procedure has been replaced by a thoracoscopic surgical approach. A thermolesion of the stellate ganglion at C7 may be helpful in complex regional pain syndrome type I and in some cases of arterial insufficiency of the upper limb (Geurts and Stolker 1993).
DISCUSSION

Up to now only few data concerning RF-lesioning in the thoracic area are available. The procedures have accepted indications, pilot studies have been done showing reasonable results, side-effects are minor if a proper technique is used. Furthermore, the techniques of PFD and PPR have been verified anatomically and standardized. Only placebo-controlled studies have to be performed to establish the place of these procedures, which will take some time, however, because of the relative infrequency of chronic thoracic pain. The outcome of the pilot studies is not only related to skills and experience, but more than anything else to proper patients selection. Anamnesis, physical examination, and careful testing procedures are essential (Stolker et al 1994a).

Test procedures may also be helpful to determine the contribution of single syndromes if a mix of pain syndromes is present in a patient. In general a PFD is done before a PPR. In all studies the success percentage is decreasing in time. This is probably due to regeneration (Hamann and Hall 1992). In the cervical area we found a half life time of 3 years (Vervest et al. 1994). In our opinion, these procedures are justified as symptomatic treatment in patients not responding to conservative measures after 3-6 months, because they show only minor side-effects and no signs of deafferentation.

LITERATURE

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