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CT-guided spinal injection: initial experience with Sprotte tip needles

Uei Pua

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Abstract
Introduction The purpose of this paper is to describe our initial experience and to illustrate the potential benefits of using small caliber (25 and 27 G), noncutting pencil point needles (Sprotte) with single puncture coaxial technique in CT-guided spinal intervention (CTSI).
Methods From January 2009 to June 2009, Sprotte needles with single puncture coaxial technique were used in a total of ten patients for selective nerve root block (SNRB), facet joint block, and pars block under CT fluoroscopy (total of 16 target structures). All procedures were performed without conscious sedation, and visual analog scale (VAS) scores were recorded to determine pain related to needle placement. Total CT fluoroscopy time and out-of-plane needle deviation were obtained. Final needle position was documented by contrast injection for SNRBs and image capture for joint space cannulation.
Results Sixteen out of the 16 structures were successfully targeted. No increase in VAS scores associated with needle placement was recorded, after infiltration of local anesthesia. Optimal peri-neurograms were obtained in all cases of SNRB, despite the side-hole opening in the Sprotte needles. Mean CT fluoroscopy time was 2 s (range 2–8 s per structure), and there was no case of out-of-plane needle deviation that required adjustment of the CT gantry.
Conclusion The use of small caliber Sprotte needles in CTSI is technically feasible and represents a potential refinement to current techniques in the management of chronic spinal pain.

U. Pua (✉)
Department of Diagnostic Radiology, Tan Tock Seng Hospital,
11 Jalan Tan Tock Seng,
Singapore, Singapore 308433
e-mail: druei@yahoo.com

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Introduction

CT-guided spinal injection (CTSI) has been shown to be safe and effective in the management of chronic back pain [1]. Noncutting pencil point needles (Sprotte tip) are widely used in the anesthesia circle for its noncutting tip that minimizes tissue trauma (Fig. 1a). Interestingly, the geometry of the pencil point tip presents a latent property that can be exploited when used in CTSI. Due to the symmetrical profile of the pencil point tip, the needle travels in a predictable straight line with negligible tip deflection. As a result, accurate needle placement can be achieved with little CT fluoroscopy and more importantly, small caliber needles (25 and 27 G) can be used with improved accuracy compared to conventional beveled tip needles (Fig. 1b). Small caliber needles afford patient comfort and potentially reduce requirements for conscious sedation. We describe our initial experience of this potential technical refinement to our current practice in CTSI.

Methods and materials

Patients and methods

From January 2009 to June 2009, ten patients from our institution underwent CTSI for chronic spinal pain, refractory to conservative treatment. Sprotte needle sets (25 or 27 G; Pajunk GmbH, Medizin Technik, West Germany) were used to target the suspected pain generators (summarized in Table 1). VAS score was charted before, during (after

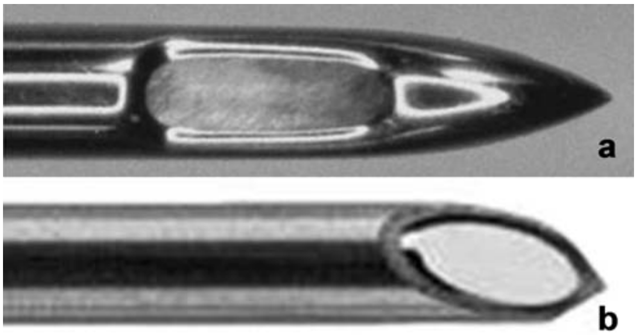

Fig. 1 **a** *Tip* of a Sprotte needle, showing the conical geometry with a side-hole opening. **b** Companion image of a standard beveled *tip* needle

infiltration of local anesthesia), and immediately after the procedure. The patients were not given conscious sedation as a routine but were offered the choice should they experience discomfort midway through the procedure. Total CT fluoroscopy time and out-of-plane needle deviation of the coaxial needle were recorded (see “Technique” section).

Technique

Planning CT images of the region of interest were obtained using multidetector CT with CT fluoroscopy (Somatom Sensation 64 cardiac CT scanner, Siemens Medical Solutions, USA) to ascertain the best approach. The display panel of the CT fluoroscopy unit displayed a “three-slice image,” comprising of a cranial and caudal slice, 1.5 mm in the *z*-axis from the central working slice. Any needle tip movement out of this “three-slice image” would require movement of the CT gantry and was considered out-of-plane deviation.

The Sprotte needle set used comprises of a short (30 mm length) beveled tip introducer needle, which are 2 G larger than the Sprotte needle and a longer Sprotte needle to be introduced coaxially. The concept is to use the introducer needle as a guide needle and a stabilizer for the flexible small caliber Sprotte needle. Briefly, after infiltration of local anesthetic, the introducer needle would be brought in line with the target structure and left in position (Fig. 2a, arrowhead). The small caliber Sprotte needle was then introduced coaxially into the introducer needle and advanced directly to the target structure (Fig. 2a, white arrow). Streak attenuation artifact (Fig. 2a, curved arrow) was used to identify the needle tip position on CT fluoroscopy. For selective nerve root block (SNRB), tip position was further confirmed by hand injection of small amount of contrast (0.2–0.5 cm^3) to obtain a perineurogram (Fig. 2b).

Results

A total of 16 out of 16 structures were successfully targeted (Table 1). The procedures were extremely well-tolerated by all ten patients, allowing all procedures to be performed without conscious sedation with no increment in VAS as a result of needle placement (after infiltration of local anesthesia). Despite the side-hole opening of the Sprotte needle, the peri-neurograms obtained for all cases of SNRBs demonstrated epidural spread of contrast similar to those seen with beveled spinal needles (Fig. 2a and b). Successful cannulation of joint spaces (facet joints and pars defects) was achieved without difficulty using this technique (Fig. 3a and b). The mean CT fluoroscopy time per target structure was 3.8 s (range 2–8 s per target structure, Table 1). There was no case of out-of-plane deviation of the Sprotte needle out of the 3 mm fluoroscopic images that

Table 1 Summary of the use of Sprotte needle sets (25 or 27 G) to target suspected pain generators of ten patients who underwent CTSI for chronic spinal pain, refractory to conservative treatment from January 2009 to June 2009.

Patient (age/sex)	Target structure	Needle calibre (G)	Total CT fluroscopy time (s)	Needle deviation (out-of-plane)
74/Female	Right L4, L5 nerve root (T)	25	6	None
55/Female	Left L3, L4 nerve root (T)	25	8	None
59/Male	Right L4 nerve root (T)	25	3	None
44/Male	Bilateral L5 pars defect (I)	27	7	None
49/Male	Right L3 nerve root (T)	27	4	None
41/Female	Left L4 nerve root (T)	25	2	None
55/Male	Right L4, L5 nerve root (T)	27	7	None
73/Female	Left C6, C7 nerve root (T)	27	16	None
53/Male	L3 bilateral facet (I)	27	7	None
72/Male	Left L4 facet(I)	25	3	None
			Av. 3.8 s per structure	

T transforminal approach (perineural location), *I* intra-articular

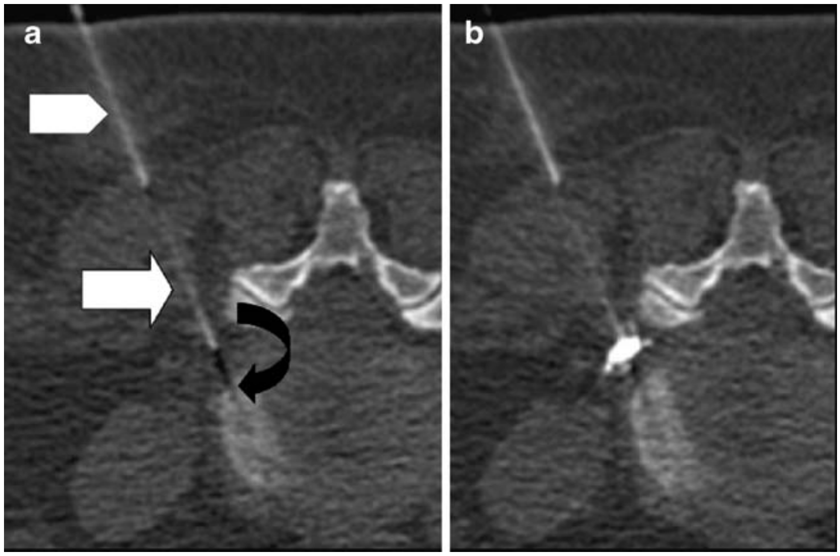

Fig. 2 **a** CT fluoroscopy image of the larger caliber 25 G introducer needle (*arrowhead*) introduced beyond the thick subcutaneous layer, lending support to the coaxially inserted small caliber 27 G Sprotte needle (*white arrow*), targeting the *left* L3 nerve root. The small streak of attenuation artifact (*curved arrow*) distal to the needle tip is useful in identifying needle tip position. Due to the geometry of the needle tip and the support of the introducer needle, the small caliber 27 G travels in a straight trajectory without deflection. **b** CT fluoroscopy showing perineural distribution of contrast following hand injection through the Sprotte needle, in a fashion similar to those seen using end-hole beveled tip needles

required movement of the CT gantry. No procedure related complication was recorded.

Discussion

The main working needle used by most operators for CTSI is the 22 G beveled tip spinal needle, while smaller caliber needles (such as 25 G) are usually reserved for injections in delicate areas such as the cervical foramina. Ideally, all spinal injections should utilize as small a needle caliber as possible to increase patient comfort, decrease procedural pain, and reduce nontarget tissue trauma. However, besides being more difficult to visualize, small caliber needles have the inherent problem of increased flexibility and are more difficult to control and steer, compared to their stiffer and

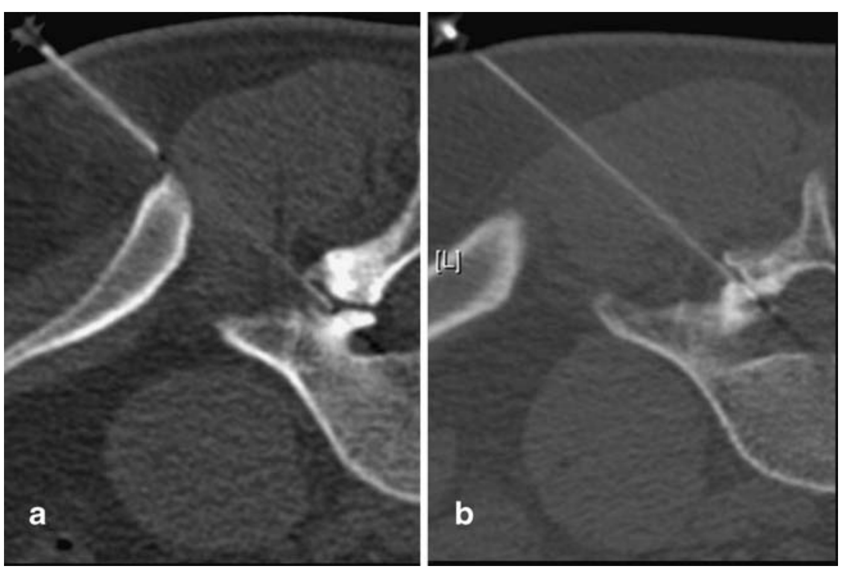

Fig. 3 CT fluoroscopy image of pars injection in two different patients. **a** Using 27 G Sprotte needle over a 25 G guide needle. **b** Using traditional 22 G beveled tip needle. The small caliber of the Sprotte needle allowed easy cannulation of the narrow pars defect (**a**), similar to that of beveled tip needle (**b**)

larger caliber counterparts. The increased flexibility can be particularly problematic during CT fluoroscopy due to the limited field of view in the *z*-axis imposed by the thin axial CT slices. As a consequence, thin and flexible needle often deviate out-of-plane from the axial slice on real-time fluoroscopy.

The Sprotte needle is an atraumatic, noncutting, symmetrical pencil point needle with a side-hole opening (Fig. 1a). The main advantage of the atraumatic tip is the significantly reduced postdural headache compared to bevel tip needles [2] and is widely used for spinal anesthesia. While postdural headache is not a significant issue with CTSI, our experience shows the geometry of the pencil point tip to be extremely advantageous. The pencil point or conical geometry of the Sprotte needle tip results in negligible needle defection, following the planned trajectory. This is in contrast to the beveled tip needles where there is needle deflection and directional bias towards the cutting edge. While the latter has been exploited by most experienced radiologists for fine control of needle direction (e.g., negotiation of hypertrophied facet joints), this property is not needed in the majority of routine CTSI where trajectory is straightforward and needle tip deviation becomes an unnecessary hindrance. We find that the amount of intermittent CT fluoroscopy can be significantly reduced with the use of Sprotte needles, due to negligible directional bias and greater predictability of the needle path. This allows for confident needle advancement in larger increments, reducing the need for intermittent fluoroscopy. This potentially affords dose conservation to both the operator and patient and reduces overall procedural time. Furthermore, cannulation of narrow joint spaces is easy when a small caliber needle is used (Fig. 3a).

Note, due to the noncutting nature of the pencil-shaped tip, an introducer needle is necessary to penetrate overlying skin and dermis. Furthermore, the 2 G larger introducer needle acts as a direction stabilizer for the flexible smaller caliber needle. Due to reports of breakage of small caliber Sprotte needle within the literature [3], forceful steering and path correction by direct application of force on the Sprotte needle is not recommended. Instead, if path correction is necessary, this can be safely performed by retracting the Sprotte needle back into the introducer needle and then directly applying external torque on the introducer needle.

We routinely use a wide window width such as bone window during CT fluoroscopy. From our experience, a small streak of attenuation artifact caused by needle tip (Fig. 2a, curved arrow) is a reliable marker for the needle tip. Hand injection of air or contrast can also be performed to document needle tip position (Fig. 2b).

Although further larger scale study is necessary to determine the actual efficacy of Sprotte needles versus conventional beveled tip needles in CTSI, our early results which encompassed our initial experience suggest that this technique potentially represents a refinement to our current techniques in management of chronic back pain.

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Conflict of interest statement We declare that we have no conflict of interest.

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