Acupuncture needle sensation: the emerging evidence

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There is a long held belief that *de qi* is important to achieve positive therapeutic outcomes in acupuncture.[1 2] Recently, a panel of experts considered adequacy of acupuncture dose from a neurophysiological perspective and suggested that a patient's sensory experience during needling (*de qi*) was important because it may be related to treatment outcome.[3] Previously, we have debated whether the intensity of acupuncture needle sensation (*de qi*) is positively correlated with analgesic outcome and whether acupuncture needle sensation can indicate adequacy of needle technique.[4] In this issue of the journal White *et al*[5] conducted a secondary analysis of data gathered in a randomised controlled clinical trial (RCT) and found no relationship between the strength of *de qi* and pain reduction for osteoarthritis of the knee and hip ***(see page 120)***. Their suggestion that less emphasis should be placed on eliciting painful *de qi* during acupuncture is certain to raise debate, although it was not clear from the report whether this recommendation extended to non-painful *de qi*.

In the past decade investigators have emphasised the need to generate needle *de qi* sensations during real but not sham interventions in RCTs. Some trials find better pain relief for real acupuncture with *de qi*,[6–9] whereas others do not.[10 11] The secondary analysis by White *et al* is important because explicit analysis of needle sensation and pain relief is lacking in previous trials. However, there were some confounders that might have biased findings toward a negative outcome. A gross indicator of *de qi* sensation was used and this may have lacked internal sensitivity. *De qi* sensation was measured using the total score of the Park needle sensation questionnaire administered once at the end of a 4-week course of treatment. Each patient was required to summarise on the questionnaire their experience of at least 48 needle interventions staggered over a 4-week period (20 min treatments, minimum of six points, twice a week). There might have been some regression to the mean for both real and placebo (non-invasive Streitberger needle) groups and total *de qi* sensation intensity scores tended to distribute in the lower half of the scale for both groups. This was less likely for pain intensity data because patients recorded average daily pain intensity each day and the mean of 7 consecutive days taken before and after the intervention. Nevertheless, mean values can mask true differences in the proportions of responders because scores tend to distribute to scale limits (ie, good pain relief or some/limited pain relief) creating a 'U' rather than Gaussian distribution.[12] This does not seem to have been the case in the study of White *et al* as seen in the distribution of change in pain data presented in their scatter graph. However, there were no differences in change of pain intensity between real and placebo groups with which to explore the *de qi* sensations. It would be interesting to see if studies with significant differences in change in pain between real and placebo acupuncture also lacked a relationship with *de qi* sensation. Despite the presence of some potential confounders the analysis is robust and the evidence suggests that *de qi* does not relate to pain relief for osteoarthritis. Whether this finding holds true for other conditions is not known.

Historically, the term *de qi* was used to represent a complicated concept within traditional Chinese medicine and traditional Chinese practitioners' needle points to achieve *de qi* as they regard it as indicating a likely effect. The definition of *de qi* is imprecise and ancient traditional Chinese medicine texts use metaphors rather than adjectives to describe the phenomenon.[1] *De qi* relates to sensations experienced in the fingers of the acupuncturist when the needle is firmly grasped by the skin of the patient (often termed needle grasp), and to sensations experienced by the patient at the site of needle insertion and radiating to other body parts (ie, acupuncture needle sensations, originally termed *zhen gan*). Research into needle sensation has focused on the development of tools to characterise and quantify these perceptual experiences and on the physiological correlates of the phenomenon using brain imaging techniques.

Early Chinese literature distinguishes painful needle sensations attributed to the needle pricking the skin from *de qi* sensations when the needle is inserted into deeper tissue. Needle 'pain' sensations were considered to reflect poor needling technique and to be unrelated to treatment outcome. MacPherson and Asghar used a group of acupuncture experts to categorise adjectives used to describe *de qi* sensations.[13] Burning, hot, hurting, pinching, pricking, sharp, shocking, stinging and tender were used to describe needle pain, and aching, dull, heavy, numb, radiating, spreading and tingling to describe needle *de qi*. White *et al*[5] found no relationship between change in pain scores and the strength of needle pain sensations or needle *de qi* sensations using the criteria developed by MacPherson and Asghar.[13] This finding is set against growing evidence from brain imaging studies that needle 'pain' sensations are associated with activation of structures in the pain matrix (eg, limbic–paralimbic–neocortical networks), whereas needle *de qi* sensations are associated

Faculty of Health, Leeds Metropolitan University, Leeds, UK

Correspondence to Professor Mark I Johnson, Faculty of Health, Leeds Metropolitan University, Civic Quarter, Leeds LS1 3HE, UK; m.johnson@leedsmet.ac.uk

with deactivation of the pain matrix, perhaps related to a reduction in clinical pain.[14–20] Whether this dichotomy of sensations is important for clinical outcome remains unknown.

It is assumed that needle sensations reflect transduction due to needle–sensory receptor coupling (eg, low and high threshold mechanosensitive receptors) or direct stimulation of the axon via needle–nerve interaction. If different needle sensations are related to different transduction processes then this may prove useful for practitioners.[21 22] Streitberger *et al*[23] used ultrasound imaging to determine whether strong *de qi* sensations were acting as a warning of impending nerve penetration by an advancing acupuncture needle. There was no relationship between an acupuncture needle contacting epineural tissues of the median nerve at P6 and the strength of *de qi*, even when there was nerve penetration, suggesting that irritation of the nerve bundle or underlying axons was not directly involved in generating *de qi*. A follow-up report of a single case found that *de qi* was achieved well before an acupuncture needle administered at P6 touched the median nerve and only slight *de qi* sensations without pain were reported when the needle entered and exited the median nerve.[24] These observations suggests that needle sensations are generated through the interaction with sensory receptors rather than irritation of the nerve and its axons. Whether a perceptual experience (sensation) occurs will also depend in part on subsequent processes of transmission and modulation of the afferent input. Stronger needle stimulation would increase impulse generation by high and low threshold mechanosensitive receptors and a stronger afferent input to the central nervous system with a concurrent increase in the strength of needle sensations.

Research in our laboratory has found that insertion of an acupuncture needle to a depth of 15–25 mm into LI10 together with bi-directional rotation generates stronger needle sensations with larger distribution patterns than superficial needle insertion (5 mm) with mock rotation.[25] Research by Langevin *et al* has shown that needle rotation causes winding of connective tissue (collagen and elastic fibres), which increases mechanical stresses in surrounding connective tissue with activation of sensory receptors away from the site of needle insertion. This might explain the spread of needle *de q'* sensations away from the needle.[26] Interestingly, our research found that needle sensation distribution patterns were markedly similar to trigger point referral patterns, leading us to speculate that needle stimulation may be affecting the same structures as those affected when stimulating trigger points[25] (figure 1).

Research on the relationship between needle sensations and neural activity is very limited, with Western acupuncture literature citing Chinese studies. For example, Kong *et al*[2] refer to a study conducted at the Shanghai Academy of traditional Chinese Medicine in 1977 which claimed that stimulation of blood vessels produced pain, nerves branches produced numbness and muscle produced soreness and distension, although we have yet to retrieve the original report to confirm the findings.[27] Commonly, commentators cite a study by Wang *et al*[28] using 34 healthy participants. These investigators recorded the characteristics of needle sensations during the vertical insertion of an acupuncture needle into an acupuncture point while recording single unit discharges of afferent neurons using microelectrodes inserted percutaneously into the nerve fascicle. Needle sensations appeared and disappeared as the

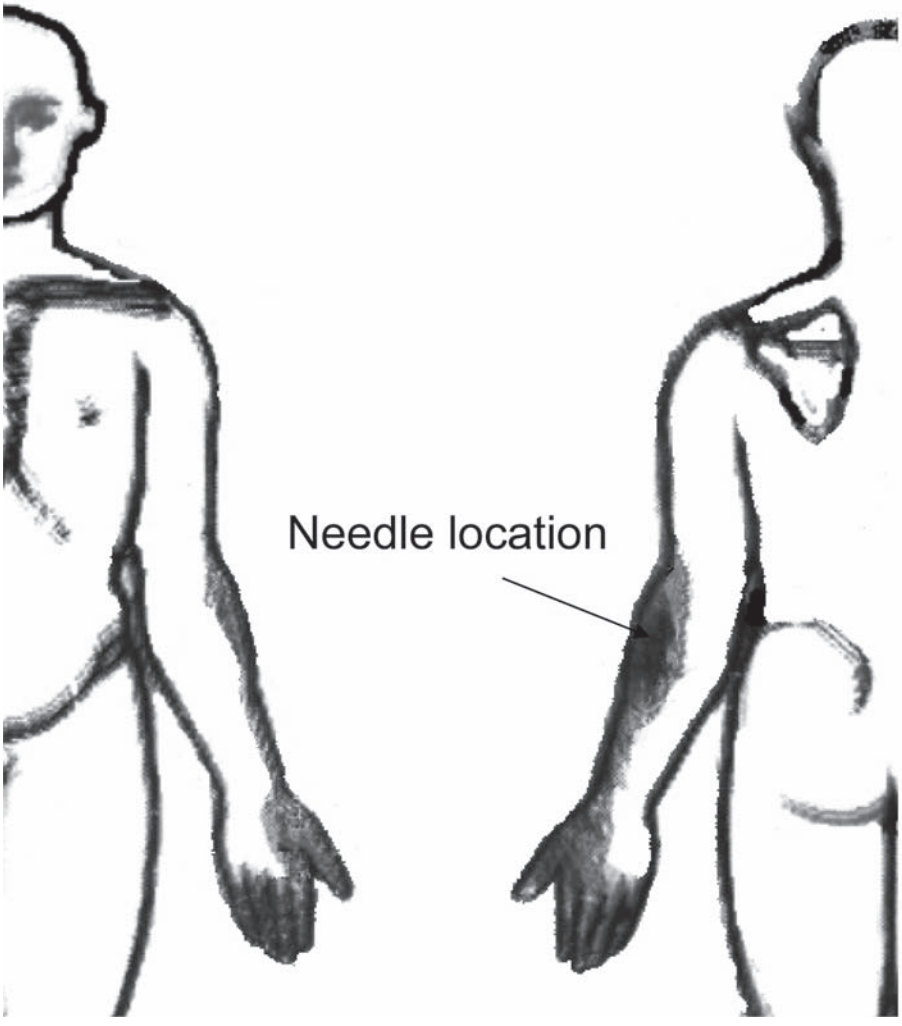

Figure 1 A composite of the distribution of needle sensation from 15 healthy human volunteers receiving a single needle inserted at LI10 to a depth of 15–25 mm with bi-directional rotation performed for 4 min.25 Darker shades indicate where more participants reported sensations.

needle was vertically inserted through the skin and discharge patterns were reported to increase and decrease according to strong and weak sensations, respectively. The investigators used fast Fourier transforms to classify unitary discharges and claimed that manual acupuncture conveyed sensations of numbness in group II (fast myelinated) afferents, heaviness and distension in group III (slow myelinated) afferents and soreness (without pain) in group IV (slow unmyelinated) afferents. When the recording microelectrodes were inserted into nerve fascicles, 'abnormal' and 'numb' sensations were also reported. It is over 25 years since the publication of this fascinating study and to our knowledge it has not been replicated using modern techniques.

If needle sensation indicates activity in different types of peripheral nerves this may be useful to clinicians. Neurophysiological evidence from the field of pain science suggests that central analgesic mechanisms differ according to the type of peripheral fibre providing the input. For example, activity in low threshold cutaneous afferents produces a rapid onset and short-lived inhibition of transmission of pain-related information in the spinal cord. In contrast, activity in low threshold muscle afferents produces a longer-lasting inhibition of transmission of pain-related information in the spinal cord.[29] Activity in higher threshold cutaneous and muscle afferents generates activity in descending pain inhibitory pathways arising from the brain, leading to more widespread pain relief. However, neurophysiological evidence from pain science is extensive, complex and difficult to interpret within the context of acupuncture. Whether needle sensation can be used to indicate different peripheral nerve input and whether this input then translates into various analgesic outcomes for different clinical conditions remains to be seen.

A systematic review of clinical studies on the effect of *de qi* on pain outcome would be useful, although this may prove difficult as it would involve screening all available RCTs in order to extract needle sensation data. From the literature on experimental pain, we discovered one pilot study using 31 participants which found that reductions in experimentally induced thermal pain were associated with needle sensations of numbness and soreness, but not with stabbing, throbbing, tingling, burning, heaviness, fullness or aching.[30] Presently, we are conducting follow-up experimental studies that precisely control needle technique while carefully monitoring needle sensations experienced and change in pain response.[25]

Sensations similar to those achieved during needling can be obtained using non-invasive techniques such as surface electrical stimulation, although the range of sensations is more limited.[31] Thus, the psychophysics of sensations evoked by peripheral nerve stimulation is not unique to acupuncture and can be studied using a neurophysiological approach and without contamination from traditional Chinese concepts. Hopefully the secondary analysis by White *et al* and the conclusion that the presence and intensity of *de qi* sensation has no effect on pain relief for patients with osteoarthritis will galvanise neurophysiological investigators to explore the phenomenon further.

Competing interests None.

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