Could acupuncture needle sensation be a predictor of analgesic response?

Alex Benham, Mark I Johnson

During acupuncture some patients experience distinct sensations which are often referred to as needle sensation. Needle sensation may be related to treatment outcome, although what constitutes adequate acupuncture needle sensation is not known. In this paper, we debate the possibility of using the self-report of the overall intensity of needle sensation as a predictor of analgesic outcome to acupuncture. We describe how our approach to establish criteria to determine adequacy of transcutaneous electrical nerve stimulation interventions in clinical trials has been used to inform our search for markers of adequacy of procedural technique for acupuncture. We describe previous research which has focused on developing tools to capture the nature of the sensations used by patients when they self-report needle sensation and reveal that little attention has been given to its role in outcome. We demonstrate that needle sensation is a complex phenomenon with subjects using multiple descriptors to report their experience. We argue that the intensity of the overall experience of needle sensation may prove useful as a gross marker of the adequacy of acupuncture. We briefly describe our research which isolates individual components of needling technique, such as depth of needle penetration and bidirectional needle rotation, in order to assess their contribution to overall needle sensation intensity.

In 2000, the British Medical Association recommended that acupuncture should be integrated into the NHS, although the recommendation was contested on grounds of insufficient good quality evidence of effectiveness. The lack of quality evidence has been attributed to difficulties in creating authentic placebo controls and to blinding patients and therapists to interventions. However, it is likely that some randomised sham-controlled trials have administered acupuncture using inappropriate technique or doses that are too low to be efficacious. This will bias findings toward no effect from the active acupuncture intervention. The use of inadequate treatment techniques in randomised controlled trials has been revealed for other peripheral nerve stimulation modalities such as transcutaneous electric nerve stimulation (TENS) and low level laser therapy. At present, specific criteria to determine whether an acupuncture intervention is adequate, and likely to be “active”, is unknown. Attempts to develop criteria have proven difficult although a group of acupuncture experts recently revived the debate in this journal by proposing a framework to define acupuncture dose. Their definition (see later) highlighted the need to take account of the patients perception of needling.

Acupuncture is often accompanied by the perception of a complex set of sensations which are considered to increase with needle stimulation. These sensations have been termed “de qi”, which is a concept derived from Traditional Chinese Medicine. De qi is frequently divided into sensations experienced by the patient during acupuncture treatment (acupuncture needle sensation) and sensations experienced by the acupuncturist whilst holding the acupuncture needle (needle grasp). It is generally accepted that needle sensation is associated with treatment outcome and should be reported in trial reports. However, there is no consensus on what constitutes an appropriate (or optimal) intensity of acupuncture needle sensation and often, the self-report of acupuncture needle sensation whilst the needle is in situ is neglected in trial reports.

ADEQUACY OF TREATMENT

In clinical practice, acupuncture interventions are tailored to the individual patient according to their clinical presentation, rather than following inflexible, prescriptive protocols. Practitioners are required to consider the number, location and depth of needling, manual stimulation technique (eg, rotation, lifting and thrusting) in addition to the duration and frequency of each treatment session. The large number of variables present within acupuncture treatment has led to inconsistencies within protocols administered during clinical trials thus introducing the possibility that some trials had under-dosed acupuncture treatment. A recent appraisal of systematic reviews on acupuncture supported this and reported that only six out of 47 systematic review methodologies included criteria for adequacy of acupuncture treatment.

Despite much published research, there is also little agreement on the dose-response profiles for other electrophysical therapeutic agents. Recently, a paradigm shift has been made in the approach to establish an appropriate procedural technique for TENS. The search for appropriate procedural technique had originally focused on optimal output settings from the TENS device, without much success. The focus was then redirected toward physiological responses indicating that appropriate procedural TENS technique had been achieved during treatment. The goal of TENS is to selectively stimulate low threshold non-noxious transmitting afferents (Aβ) without simultaneously activating high threshold noxious transmitting afferents (Aδ). Activity in low threshold afferents inhibits ongoing transmission of nociceptive pain-related information using a segmental mechanism leading to pain relief. Strong, non-painful sensations (TENS paraesthesiae) are indicative of selective low threshold afferent activity. The self-reported perception of strong, non-painful TENS sensations used at the site of pain were used as a criterion for appropriate procedural technique for TENS. A meta-analysis using this criterion a priori found that larger reductions in postoperative analgesic consumption occurred when TENS was applied adequately compared to when TENS was not applied adequately (ie, TENS sensation absent and/or administered away from the site of pain). Hence, the patient’s self report of TENS sensation appeared to be pivotal in treatment outcome and could be used as a marker for appropriate procedural technique for pain relief. We are now taking a similar approach for acupuncture by investigating the possibility that adequacy of acupuncture could be indicated through the verbal report of the intensity of needle sensation.

Acupuncture experts have recently defined acupuncture dose as “The physical procedures applied during the session, using one or more needles, taking account of the patients resulting perception (sensory, affective, cognitive) and other responses” This definition acknowledges a value in considering physiological responses during acupuncture treatment, although, in line with previous research, an emphasis was placed upon the importance of the nature of needle sensations experienced. The variety of needle sensations may reflect the variety of structures stimulated during needling.
PHYSIOLOGICAL INTENTION OF NEEDLING
For many years the accepted, although simplistic, view has been that acupuncture analgesia results from the needle-induced activation of Aδ and C afferent fibres which in turn activate descending pain inhibitory pathways with a concurrent release of endogenous opioids. Evidence from basic science suggests that activity in low threshold afferents produces short lasting inhibition of nociceptive transmission via segmental mechanisms, whereas stimulation of higher threshold afferents produces longer lasting inhibition of nociceptive information via descending pain inhibitory pathways. However, single unit nerve recording techniques in rats has shown that acupuncture needle stimulation activates all types of single afferent nerve fibres (ie, groups I, II, III and IV). It is also likely that autonomic and motor efferents are involved too because of the wide variety of clinical, physiological and psychological effects observed during and after acupuncture stimulation.

Recently, it has been suggested that tactile afferents may play a role in needle stimulation, adding to the growing list of structures implicated, including polymodal receptors, pressure receptors, muscle spindles and tendon organs to name but a few. Language et al have demonstrated that bi-directional rotation of a needle when placed deep in muscle tissue causes connective tissue fibres to get caught around the tip of the needle, stimulating intra-muscular primary afferents. This coupling between the needle and connective tissue has been linked to the “needle grasp” and such needle rotation has been identified as a potential stimulus to connective tissue cells via mechanotransduction. How this influences needle sensation is uncertain.

There have been few attempts to characterise the physiological correlates of needle sensations. Research on Chinese subjects which monitored afferent fibre discharge and self reported sensation reported that Group II (Aδ) afferents conveyed numbness, Group III (Aδ) heaviness and distension, and Group IV (C-fibre) soreness. A comparison between different forms of stimulation reported that needle stimulation produced aching sensations whereas TENS and electroacupuncture produced tingling sensations, suggesting qualitative differences between manual and electrical stimulation. Hui et al found that sensations were elicited in 71% of acupuncture stimulation procedures and 24% of gentle non-invasive tactile control stimulation procedures in acupuncture naïve healthy adult volunteers. Acupuncture stimulation generated aching, soreness and pressure, followed by tingling, numbness, dull pain, heaviness, warmth, fullness and coolness. However, the complexity of the pattern of sensations led authors to conclude that a wide spectrum of myelinated and unmyelinated fibres, particularly the slower conducting fibres in the tendinomuscular layers were involved. Characterising this complex pattern of sensations has proven difficult.

CHARACTERISTICS OF ACUPUNCTURE NEEDLE SENSATION
The perception of acupuncture needle sensation appears to vary considerably between patients and needling techniques. Quantitative analysis of needle sensations has proved difficult due to the diverse range of adjectives used to describe the phenomenon. A large majority of the previous needle sensation literature has been concerned with developing tools to characterise and quantify the many descriptors used by patients when self-reporting needle sensations.

The original Acupuncture Sensation Scale was a multiple adjective sensation rating scale based on 25 descriptors from the McGill Pain Questionnaire. Park et al translated the Acupuncture Sensation Scale for use on Korean healthy, pain-free volunteers and reported that common descriptors were aching, spreading, radiating, pricking and stinging. Sensations were not restricted to “pain-related” descriptors. Kong et al developed a Subjective Acupuncture Sensation Scale comprising nine descriptors and concluded that needle sensation was complex with subjects using multiple descriptors. A study where an international group of acupuncture experts rated the importance of descriptors on an established needle sensation scale found two clusters of sensations:

1. de qi, including aching, dull, heavy, numb, radiating, spreading and tingling,
2. acute pain at the site of needling including burning, hot, hurting, pinching, pricking, sharp, shocking, stinging and tender.

A scale has been developed to collect needle sensations from Chinese patients, with common descriptors being distended, sore, electric and numb. Interestingly, patients described sensations as “migratory” rather than static, suggesting that local and distal physiological factors may be contributing to sensations. Recently, the Massachusetts General Hospital Acupuncture Sensation Scale and the 17 item Southampton Needle Sensation Questionnaire have been reported. Development of the Southampton Needle Sensation Questionnaire revealed two clusters of sensation as “Aching de qi” (seven items with a close relationship to painful needle sensations) and “Tingling de qi” (seven items unrelated to painful sensations). Despite the development of a variety of tools to capture needle sensations, research on the relationship between acupuncture needle stimulation and needle sensation is relatively embryonic.

The notion that acupuncture needle sensation is linked to analgesic outcome is not new, yet research is sparse. Vincent et al found no differences in needle sensations between true and sham (non-classical) needling sites under blinded conditions. Conversely, Park et al reported a high relative risk of experiencing needle sensations with real acupuncture compared with a non-penetrating sham acupuncture needle. They used consensus judgement of three acupuncture experts on whether or not volunteers had experienced needle sensation, but they did not report actual descriptors of needle sensation.

A pilot study comparing the analgesic effects of manual acupuncture, electroacupuncture and non-penetrative acupuncture found a relationship between hypalgesia to experimentally-induced pain with needle sensations of numbness and soreness, but not with ratings of stabbing, throbbing, tingling, burning, heaviness, fullness or aching. However, the authors concluded that needle sensation was complex with subjects using multiple descriptors. It is for this reason we believe that the overall intensity of needle sensation may have greater utility as a marker of the adequacy of acupuncture.

INITIAL INVESTIGATIONS
We have instigated a programme of research to investigate the effect of the overall intensity of needle sensations on pain. Our preliminary work on healthy human participants suggests that the depth and stimulation of acupuncture needles may affect the perception of needle sensation (paper in submission). These findings have informed the design of a further study to compare the response of healthy humans to experimentally induced pain in the presence and absence of needle sensation.

SUMMARY
The negative findings of some randomised control trials on acupuncture may be due to the use of inadequate procedural
technique due to continued uncertainty of optimum treatment protocols. We support previous calls for the need to investigate the role of needle sensation in analgesic outcome. The majority of previous research has focused on qualitative descriptions of components of needle sensations and has concluded that needle-generating a complex array of sensations resulting in a plethora of descriptors. It is for this reason that we have instigated a programme of research to explore the role of intensity of overall needle sensation in outcome.

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