The relevance of childhood developmental factors to the efficacy of acupuncture on the affective component of back pain

Nicholas Straiton

There is substantial evidence to support the use of acupuncture in the treatment of low back pain. The main predictors of chronic low back pain are non-medical and psychosocial. The understanding of how acupuncture can modulate the pain experience has recently been enhanced by the elucidation of the role of C fibre afferents on the limbic system. C fibre deactivation of the limbic system can only occur in the presence of intact corticospinal neuronal pathways. The normal development of these pathways is determined by social factors in the early years of life. The effect of acupuncture treatment for low back pain may be determined by successful relationships between the mother and child in the first 18 months of life.

Over the last few years, there have been a number of papers published providing evidence that acupuncture can be effective in the treatment of low back pain. Similarly there is some evidence that manual therapy can also be effective. Why some patients should respond to these forms of treatment and not others is difficult to explain and unpredictable. One of the problems in treating back pain is the non-specific nature of the complaint and the difficulty in making a specific diagnosis. It is estimated that identifiable pathology is present in only 15% of patients complaining of back pain. Thus, for simple back pain, treatment is usually carried out on an empirical basis patients receiving increasing intervention forms of treatment following failure of simpler measures or physical forms of treatment being abandoned in favour of a pain-management approach.

One of the greatest difficulties is in understanding what the complaint of pain represents or where it is coming from. Pain is defined as “an unpleasant, sensory and emotional experience, associated with actual or potential tissue damage, or defined in terms of such damage,” and therefore prior to formulating some form of treatment plan we need to consider whether we are dealing with a predominantly sensory or emotional phenomenon.

Of course the reality is that in most cases there is a component of both, but treatment will be doomed to failure if we fail to recognise which component is the most relevant to the patient’s condition. Giving an epidural injection to a patient whose back pain is a manifestation of emotional distress will be just as unsuccessful as treating a patient suffering from discitis with cognitive behavioural therapy, although perhaps more forgivable and less likely to lead to litigation. It would be logical to assume, but in reality too simplistic, that in patients who are suffering from a predominantly sensory component of pain (disc prolapse, acute spinal dysfunction, etc), a physical approach would be more likely to be successful, and in patients where the pain experience is emotionally based, a more psychologically based approach would be favourable. However, this is not necessary the case, and I would like to consider how various therapies which involve stimulation of skin receptors important in the perception of touch may have a positive effect on the emotional component of the pain experience.

MECHANISMS OF EFFECT

For many years, acupuncturists have recognised how some patients react in an extremely sensitive way to needle stimulation. These “strong reactors” with fairly minimal stimulation manifest surprising reactions such as intense relaxation, sleepiness or even euphoria. It has been difficult to explain this phenomenon, but with the advent of PET and fMRI scanning, there is now abundant research mapping the function of different areas of the brain which can give us some possible explanations for these effects of acupuncture treatment and also the effect on the affective component of the pain experience. There are sound neurophysiological explanations to explain how acupuncture may work, and it is quite widely accepted that part of the pain-relieving mechanism of acupuncture is caused by the stimulation of alpha delta neurons creating an effect at the spinal cord level and centrally by precipitating activity in the descending inhibitory pathways. However, it has also been suggested that it could also work by stimulating the limbic system, which could explain to some degree its pleasurable effect and the reduction in the affective component of pain. To understand how this could work, let us briefly consider the central neuronal mechanisms that may be relevant to this process. The amygdala, part of the limbic system, is felt to be vital in the processing and regulation of emotions. Stimulation of the central nucleus of the amygdala will feed into the pituitary/hypothalamic axis, setting off a fear response. Sensory information can reach the lateral nucleus of the amygdala in two ways, directly via the thalamus or indirectly from the thalamus to the sensory region of the frontal cortex where a more detailed representation of the stimulus is constructed, at the expense of time, and then passed back to the amygdala. The amygdala has projections back to this area and also with long-term memory networks importantly directing attention to emotionally relevant stimuli. Sensory information will pass to the prefrontal areas where meaning will be ascribed. Pathways pass from this area of the brain back to the amygdala, and these are felt to be very important in the extinction of the fear response but are less numerous to pathways passing in the opposite direction.

In summary, sensory information, for example back pain, will influence the amygdala in two ways, first crude representation directly from the thalamus and second via the cortex. In this way, the body can react automatically to stimuli that question survival but allow this response to be tempered by the more detailed cortical representation combined with long-term memory data. Both of these pathways feed into the lateral nucleus of the amygdala which, via internuclei networks, have the option to maintain or extinguish the automatic fear response. Thus, when considering back pain, one must recognise that the emotional component of this will be profoundly influenced not only by the integrity of the central neural mechanisms but also by the ascribed meaning to the pain and previous experience.

Campbell summarised the current understanding of the role of C tactile fibres and their effect on the limbic system. There is now evidence on fMRI studies that acupuncture may produce some of its effect by modulating activity in the limbic system and subcortical areas of the brain.
was due to the activation of C tactile afferents. It had been known for a long time that unmyelinated fibres responsive to touch were present in non-mammals, but it was not until 1990 that they had been discovered in the human face and, more recently, in hairy skin. Olaussson et al reported the discovery that light touch of the skin stimulates mechanoreceptors to slow conducting unmyelinated C afferents that produce activity in the insula region but not in the somatosensory cortex. Campbell commented that the clinical effects of acupuncture and other manual therapies could be explained by postulating the limbic system as the final common pathway. He also mentioned that unlike most primates, human beings are unusual in the fact that they indulge in grooming only under special circumstances such as between mother and child or between sexual partners. He went on to suggest that there was an evolutionary need of such contact to maintain physical and mental well-being. However, I believe that there is another explanation as to why human beings have developed the neural circuitry that can cause relief of pain by pleasurable tactile stimulation.

FACTORS AFFECTING CORTICAL DEVELOPMENT IN THE CHILD
To understand this phenomenon, we need to go back to the early years of childhood which are so critical to the development of the prefrontal cortex and to recognise that the successful development of the orbitofrontal region is to a large degree dependent on social interaction, which is in essence the progressive development in the hierarchy of communication between child and mother. The first and foremost form of communication is touch, visual cues and speech progressively being added.

At birth, the orbitofrontal cortex is non-existent, but by toddlerhood, it is well on to maturity, so this 18-month period is critical. Research on Romanian orphans has shown in fMRI imaging that there is virtually a black hole where the prefrontal cortex should be in children who are deprived of social interaction. In the first year, a child is in a totally dependent state; it has very little functioning sensory apparatus or conscious decision-making ability to make sense of and react to its external or internal environment; and it needs someone to teach the survival relevance of sensory information. The prefrontal cortical function develops to a greater extent postnatally. To a degree, the newly born child’s highest functioning neural centre is the reptilian part of our brain, the subcortical centres which respond to certain stimuli with palaeocircuitry in a preorganised way. For example, a loud noise, large overhanging shape or shadow will activate the amygdala which will instantaneously respond, activating a “flight or fight” response and producing an altered body state signalling the emotion distress. This instant response to potential danger by the amygdala is tempered in the adult by the interpretation and rationalisation of the same sensory information feeding into the cortex milliseconds later. This rationalisation being absent, the baby cries, and the mother responds by soothing, which involves stroking. The purpose of the C unmyelinated fibres is to communicate this action to the insula, the cortical part of the limbic system important in body representation and subjective emotional experience, which in turn will communicate this to the prefrontal cortex. This area of the brain in turn puts things together, that is the stimulus and the feeling, maintaining and effecting further survival action if necessary or sounding the all clear by sending messages to the subcortical area to turn off the amygdala response. The more this experience is repeated, the more neuronal connections will be made between the cortical and subcortical areas and the more efficient the system will become.

Therefore, cortical development and the establishment of corticosubcortical pathways are very much dependent on the quantity and quality of social interactions. Connections that are not used will atrophy, the so-called “pruning” of the brain.

HIERARCHY OF COMMUNICATION
As the baby’s brain develops, this process will be repeated using more sophisticated sensory information such as visual cues and finally speech. Thus, the ultimate ability for the prefrontal cortex to turn off the primitive arousal mechanisms in the midbrain is dependent on the quantity and quality of positive social interactions with the infant’s mother or primary care giver. The quality of these early sensory limbic connections will determine the responsiveness to touch in adult life. It would follow that in a similar fashion, the quality of the more sophisticated forms of infant communication experience, ultimately word-based, may similarly determine the patient’s responsiveness to word-based treatment, whether this may be simple explanations and assurance from the GP, psychotherapy or enrolment on a pain-management programme.

PRACTICAL APPLICATION FOR THE THERAPIST
Thus, it could be predicted that patients who have had a very healthy attachment with their mothers in the early years would have a very responsive nervous system and could well be the strong reactors that acupuncturists over the years have observed or indeed the patients, in a general medical setting, who are easily reassured and comforted by a rational explanation as to the cause of their symptoms. In the same way, patients who are unresponsive to acupuncture or other manual therapies may have had very poor early attachment relationships. Of course, this is a very simplistic explanation of an immensely complex process, and as is the case in most biological systems, there is in all probability a continuum of responsiveness. As a corollary to this, another crucial response of a poor early attachment relationship will be the adult’s relative inability to shut down primitive emotional responses by activity in the higher centres, making them particularly prone to stress which may well manifest itself in a number of psychosomatic symptoms. An important part of a successful early attachment relationship is that the image of the soother of the child’s aroused subcortex will ultimately be internalised in the prefrontal cortical and temporal areas of the brain ready to be accessed in times of stress to serve the purpose of the former externalised early primary carer.

Part of the adult back-pain sufferer’s discomfort may be due a state of arousal, and success of treatment could be determined by the practitioner’s ability to turn this response off or down by physical or verbal means. By touch, speech or more subtle forms of communication, the practitioner is tuning into the vestiges of a mechanism vital to survival and the healthy emotional development of the child. Success of treatment may be determined partly by the practitioners’ skill but also by whether the patient is able to respond to this form of interaction with another human being. If the neuronal pathways between the cortex and subcortical pathways are completely deficient, intervention is unlikely to be successful. However, in all probability, these pathways are never completely deficient and can still be improved upon in the adult if used.

MANUAL THERAPY
Many different schools of manual therapy have developed over the years from those described by Hippocrates to our modern-day state-regulated physiotherapists,
osteoarthritis. Each favours their own techniques which superficially do seem specific, although it seems to be difficult to easily prove that one is better than another. This more generalised modulation of the subcortical region of the brain that I have been describing, due to touch, the common denominator in these various forms of treatment, could be the basis of their effect.27

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