A Submission for The Anaesthesia History Prize

The History of 'Biopsychosocial' Pain – A tale of Gladiators, War, Papal Doctrine and a Wrestler.

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The biopsychosocial model of illness was first presented in 1977 by George Engel[(1)]. His landmark idea described a dynamic interaction between psychological, social and pathophysiological variables, and highlighted the hypothesis that, the workings of the mind, could affect the body, as much as the workings of the body, could affect the mind. Such a model has since been recognised in explaining chronic pain syndromes and has lead to an important shift in the way that pain is researched, diagnosed and treated. Originally the formula was applied to pain by Fordyce[(2)] and Loeser[(3)] in the 1970s and 1980s but the construct has blossomed over the last 30 years with a wealth of supporting studies and philosophies.

However, can it really be argued that the biopsychosocial model of pain is a 20th century idea? Theories explaining pain have swung from physiological to psychological, from holistic to dualistic, from specificity

to intensity for hundreds of years. It could, therefore, be argued that the biopsychosocial model of pain has been evident throughout history and that where the focus lay within the model was dependent on the social, scientific and cultural beliefs of the time.

As long ago as ancient Greece, pain was philosophised to be an emotional construct, often described as a 'passion of the soul' [(4)]. This focus on the psychological and emotive aspects of pain no doubt arouse because of the dual function of the physician, as philosopher and medic. Aristotle (384-322BC) described pain as the opposite to pleasure[(4)] and as a central sensory function derived from peripheral stimulation[(5)]. This is the first evidence of one side of a debate which has continued in pain medicine for centuries – whether pain is purely a sensation or an emotional experience, a complex need state.

The Greek view of pain as a passion of the soul could be viewed as a lack of understanding of basic physiology and anatomy, and indeed Aristotle's insistence that pain was experienced in the heart, not the brain, shows that all the parts of the puzzle were far from correct. The fact that two of Ancient Greece's greatest philosophers, Plato and Aristotle, practised the theory of holism in their medicine[(6)] gives us an idea of how pain would have been tackled. Holism states that the study of a disease must take into account the whole person, rather than just the diseased part. A concept that many patient groups would agree with today. Plato, perhaps without

realising himself, showed an appreciation of how higher cerebral functioning could affect the perception of pain, through the use of distraction techniques; ‘ I said that the cure itself is a certain leaf, but in addition to the drug there is a certain charm, which if someone chants when he makes use of it, the medicine altogether restores him to health, but without the charm there is no profit from the leaf’[(7)].

The Romans also had strong ideas about pain medicine. Galen (131-201AD), perhaps the most famous Roman physician, used his appointment as an ancient day, pitch-side medic, to investigate wounds inflicted on gladiators and wild beasts in the amphitheatre. This along with animal vivisection allowed him to develop an appreciation of neuroanatomy, and to hypothesise an early anatomical pain pathway[(8)]. However, he was not a biological purist and his background in philosophy meant that he appreciated the complex interactions between mind and body. In his study of psychological disease he describes how mental disturbances arose not only if the brain was directly affected, but also if other organs were afflicted[(9)]. He purportedly added a fifth sign to Celsus’ four original signs of inflammation – redness, swelling, heat and pain - in the form of ‘disturbed function’[(8)]. This highlights an appreciation for the functional component of pain and its importance to the life of the patient, which is often more detrimental than the pain sensation itself. In Roman times it was widely appreciated that the mind

had a large influence on the workings of the body and that symptoms could be alleviated by thought processes. For example, Cicero (106-43BC) stated that emotive factors can give rise to physical illness and that 'man can help his own cure through philosophy'[9] – potentially an early form of cognitive behavioural therapy!

As with so many forward thinking philosophical and scientific concepts from the ancient era, theories about the origins of pain became enshrined in religious mystery during the Dark Ages. Pain was linked to the theory of original sin[5]. Biblical teachings on pain were taken literally – ' God told Eve: I will greatly multiply your pain in childbearing; in pain you shall bring forth children.' (Genesis 3:16). Pain was viewed as a punishment from God which should be endured; indeed the Latin word for pain, 'poena', can literally also be translated as 'punishment'. This theological belief structure surrounding pain persisted well into the nineteenth century, outlasting the advent of effective analgesic and anaesthetic agents. It was not until Queen Victoria was administered chloroform for the birth of her seventh child in 1850 that the use of anaesthetics and analgesics gained credibility in childbirth[10]. Similarly, after the discovery of tourniquet anaesthesia, it became common practice for the upper classes to request permission for its' use from the Pope before undergoing an operation[5] so as to be reassured that they were not escaping a punishment from God. Well into the nineteenth century, a

doctor would use a type of ‘religious and moral calculus’ to determine which patients were of ‘correct sensibility’ to need or benefit from surgical anaesthesia[11].

It therefore could be argued that the religious doctrine on the origins of pain heavily incorporates a biopsychosocial message. The Church held a great deal of power over its congregation in Medieval times through fear and mystery. Emphasising the role of sin in pain would have had a profound psychological and social impact on the injured and sick and goes some way in explaining why so little progress was made in pain management in the Western world until the Enlightenment. Focus slipped away from the physiological and philosophical view of the Ancient World and developed into a confusing contradiction of suffering and punishment, martyrdom and exclusion.

The blossoming of science, philosophy and the arts that surrounded the Enlightenment had a huge impact on how pain was interpreted. Descartes developed the Theory of Dualism in the 1600s[12] which described the separation of the body and the spirit as two separate entities. Pain was described as being produced by bodily mechanisms but being perceived by the soul[13]. This theory was at odds with the holistic view of the Greeks and highlighted the shift from a religious or philosophical aetiology to a physiological source.

The Cartesian dualistic theory was largely accepted well into the twentieth century. The obvious flaw in the theory was the reliance on an overt stimulus and the causal link between tissue damage and pain. Patients who complained of pain but had no evidence of injury, and conversely, those with large injuries but little sensation of pain, were neatly explained as having 'illegitimate' pain; they were declared insane and therefore untreatable by medicine[(12)].

Such a focus on a physiological or anatomical explanation for pain has often hampered the understanding and treatment of pain and is a battle that is still fought today, despite a widespread acceptance of the biopsychosocial model. This separation of body and spirit is easy to understand in the historical and societal context. The separation of Church and State mirrored this theoretical separation of body and soul and penetrated all areas of life. At the same time, dissection and observation became an acceptable mainstay of scientific practice.

Pain transmission remained a mystery. Galen had proposed a peripheral set of nerves connected to the brain, but the heart had more widespread support as the organ of pain sensation, and Harvey's discovery of the circulation in 1889 seemed to support this[(14)]. The main problem with attributing pain sensation to the nervous system seemed to be that nerves, at dissection, did not appear to be hollow, as veins and arteries were, therefore could not transmit the 'animal spirits' responsible for pain

perception[15]. Anatomy alone could not answer the question of how a peripheral stimulus caused a sensation perceived in the brain. Nonetheless, anatomists such as Benedetti, as early as 1497, stated that 'By means of nerves, the pathways of the senses are distributed like the roots and fibres of a tree'[16] and ultimately both Harvey and Descartes recognised the importance of the nervous system in pain.

Advancing physiological understanding sparked a new debate in pain perception in the late nineteenth century. Although pain was recognised as a sensation related to the disorder of the nervous system, the overlap between the non-painful sensation and pain could not be explained. Von Frey in 1895[4] attempted to divide the senses into four broad groups, each with their own free nerve endings and pathways in the nervous system. He termed these the cutaneous senses – touch, cold, warmth and pain and so coined the Specific theory of Pain, in which pain was described as a separate sensation. Muller and Bell in the 1840s agreed as they observed that the stimulation of a single nerve always produced the same sensation[17]. This theory has of course been supported to some extent by the discovery of A delta and C pain fibres, the spinothalamic tracts and some specific 'pain centres' in the brain. However, such a simplistic view could not explain several phenomena, such as the failure of neurotomy to produce analgesia and symptoms such as hyperalgesia.

Opposition to the specific theory came in the form of the theory of intensity put forward by Weber in 1846[18]. Weber was an experimental psychologist who argued that weak stimulation of nerve endings produced an awareness of the body, whilst strong stimulation, above a critical threshold, produced pain. The idea that pain did not have a specific pathway was developed by Erb and Goldsheider in the twentieth century as the 'pattern theory' of pain where certain patterns of stimulation caused the sensation of touch, whilst a different pattern, involving the same neural systems, caused the sensation of pain[19]. However, this doctrine largely ignores the physiological evidence for receptor specialisation and has since lost support.

Despite growing physiological evidence, in Victorian times, the view that pain was an inevitable and even beneficial part of life remained. Pain was widely viewed as a sign of a patients vitality: one Victorian physician stated ' The greater the pain, the greater must be our confidence in the power and energy of life'[11]. Pain was even inflicted as a treatment for certain diseases. It was thought that pain was a sign of ill humours or evil spirits leaving the body and therefore acted as a cure[5]. This superstitious or even spiritual view of pain often hampered physicians, intent on offering analgesia, and seemed to be a hangover from religious teachings linking pain with evilness and sin. In this way, social pressures must have

caused huge problems for both patient and physician in the form of altered pain behaviours and attitudes to analgesia.

Nonetheless, it was anatomical and physiological arguments that dominated pain research until the middle of the twentieth century. And, although this led to a large increase in our understanding of pain transmission, it did little to advance the management of patients with pain conditions, as the pain experience as a whole, and the impairment of function was largely ignored. One notable exception was the psychologist Henry Rutgers Marshall, who argued the importance of regarding pain as an emotion, rather than a sensation[20]. He described pain as the opposite to pleasure, perhaps a nod to Aristotle's suggestion, and proposed more psychological and behavioural methods for treating patients with pain disorders. However, the importance of the psychological state and the patients' surroundings, although recognised in Ancient times, took a back seat to exciting neurophysiological developments. It could even be argued that it took a World War to get physicians to look further afield for answers to the pain problem.

Wars have long been recognised for having an impact on clinical medicine and for the rapid advancement in understanding and treating injury conditions, and pain is no exception. The American Civil War (1861-1865) led Weir Mitchell to study phantom limb pain and causalgia. He highlighted a contradiction in the dualistic theory of pain, as his

soldiers still complained of pain even after injuries had healed and after limbs had been removed; ‘ the most terrible tortures which a nerve wound may inflict… under such torments… the most amiable grow irritable, the soldier becomes a coward, and the strongest man is scarcely less nervous than the most hysterical girl.’[(11)]. Here he recognises the functional and psychological impact of chronic pain and the social isolation of a soldier no longer able to carry out his duties, despite having no overt, active injury. His argument that these chronic pain states disproved the dualistic theory was soon rejected in the late 1800s as neuroanatomical knowledge grew.

The First World War brought a resurgence of interest into chronic pain. Chronic pain sufferers were regarded as malingerers, addicts or psychologically ill because of the dominance of the specificity theory. However, some recognised the similarity in symptoms of returning soldiers and began to explore ways to treat them beyond the use of opiates. The French surgeon, Leriche developed sympathetic ganglia blockade and devascularisation techniques and promoted the use of procaine to provide analgesia for his problem patients [(21)]. The development of surgical and pharmacological techniques to treat chronic pain was in keeping with the focus of pain management on the biological disturbance.

It was not until the Second World War that the importance of the psychosocial component of chronic pain came back into fashion. Henry Beecher observed that soldiers in military hospital reported much lower pain levels in comparison to civilians with similar injuries [(11)]. He inferred that the pain experience was a complicated mixture of physical injury and emotional and cognitive reaction to the sensation. He noticed that combatants required less opiates and exhibited less suffering behaviours than civilians, and hypothesised that this was due to the positive connotations associated with injury afflicted in war. It could therefore be argued that Beecher, in 1946, was the first to truly observe the complexities of pain and all its biopsychosocial components.

John J. Bonica was a physician at the Madigan Army Hospital in Washington during the Second World War. He was himself a chronic pain sufferer, having accumulated shoulder injuries during his time as a champion wrestler[(22)]. He became increasingly frustrated at his inability to effectively manage pain conditions in returning soldiers. He noticed that the soldiers who achieved the best functional outcome had received input from many different areas of the medical profession. After the war he investigated the idea of a multidisciplinary team approach and set up a pain clinic at Tacoma General Hospital that involved anaesthetists, neurosurgeons, orthopods, medics, psychologists and radiologists [(23)]. His concept of multimodal pain management, which he published in 1953,

despite showing encouraging results, was not widely accepted. It was not until the development of the gate control theory of pain in the 1960s and the widespread acceptance of psychological methods that the true value of his work was recognised.

In the 1950s and 1960s there was a growing realisation that despite many advances in neurobiology and pharmacology, physicians were still unable to tackle complex pain problems effectively. There was a gradual realisation that structural disease correlated poorly with symptoms and behaviour. This led to a change in focus away from ‘stimulation’ and ‘sensation’ and towards ‘perception’ and ‘behaviour’. To explore a patient’s perception and reaction to pain, research intensified in the psychological and sociological fields. Hardy, in 1952, proposed a theory where the specificity model was divided into perception and reaction; he stated that the perception of pain could easily be explained by simple physiological processes, but that the reaction was depended on past exposure to pain and cultural influences[24]. This idea has been developed into the ‘forth theory of pain’ which highlights the one to one relationship between stimulus and perception, but a more complex interaction to bring about a reaction[4].

Melzack and Wall’s ground breaking work in 1965 attempted to combine what was understood physiologically with what was observed psychologically and emotionally[25]. The Gate Control Theory describes a

system where pain is not an inevitable consequence of stimulation of nociceptors but is dependent on higher cortical functions such as attention and meaning. This model fitted neatly with Bonica's earlier observations and shows that the world of pain research was heading towards a biopsychological model over ten years before Engel published his work. The change in thinking coincided with the growth of the Hospice movement and the development of Dame Cicely Saunders' concept of 'total pain'. Palliative care in the 1950s was a new specialty and physicians began to recognise the impact of depression, anger, anxiety and social isolation on their patients' perception of their symptoms. This was particularly obvious with pain, and early trials highlighted how the reaction to pain could be lessened without pharmacological intervention but with talking therapies and careful explanation of symptoms and disease processes[26].

In the 1960s there was an explosion of psychological papers arguing that therapeutic strategies for pain should target conditioning and relearning, and that traditional pharmacology was only treating a symptom, not the underlying problem, so could never be a 'cure'[27]. Fordyce was a vocal proponent of the psychological and behavioural importance in pain in the 1960s and produced new evidence that cognitive behavioural therapy was effective. He was the first to introduce specific ideas about operant

conditioning and the environment, and so developed the emerging biopsychological theory into a biopsychosocial model[28].

Fagerhaugh, in 1974, also recognised the impact of the outside world on ones perception of pain. His observational studies in a burns unit showed that stoical behaviours were adopted by patients surrounded by other, similarly stoical, patients and that detrimental, passive coping behaviours could also spread throughout a ward[29].

The American Pain Society has since discussed the idea of the 'swinging pendulum' in the 1960s, which appears to show financial influence on the world of pain research [29]. Insurance companies in the States were accumulating more and more chronic pain patients and thought that a psychological intervention, where the patient was encouraged to be responsible for the management of their own symptoms, provided a cheap answer to their prayers. This meant that psychological therapies at this time often had financial backing to carry out large trials. However, they had not appreciated the cost of implementing such services and, consequently, the cost passed onto the insurance companies themselves. Gradually the pendulum swung back the other way and financial support was given to drug trials in the hope of finding, somewhat unrealistically, a cheaper golden bullet to treat all pain problems[29]. This is another example of how social pressures affected the course of pain research.

Engel's concise description of illness within the biopsychosocial model fitted perfectly the growing functional and psychological impetus in the world of pain research in 1977. The International Association for the Study of Pain was founded in 1973 by Bonica, to bring together the growing areas of science involved in the development of pain medicine. The biopsychosocial model of pain was widely accepted at the IASP which is evident in the publication of a familiar definition of pain in 1979 as an 'unpleasant sensory and emotional experience associated with actual or potential tissue damage'[(22)]. The word 'experience' can be viewed as a psychological condition, which has affective qualities. However, many have since argued that the definition does not incorporate enough motivational and behavioural aspects of pain[(30)]. In an early edition of the IASPs publication, Pain, Wall, despite being a physiologist, clearly accepts the importance of the biopsychosocial model as he states that ' pain is better defined as an awareness of a need state rather than a sensation…it has more in common with the phenomenon of hunger and thirst than with seeing or hearing…in each stage it is shown that pain has only weak connection to injury but a strong connection to body state' [(31)]. From the 1980s until today, many pain scientists, psychologists and philosophers have adapted and provided more evidence in support of the importance of the biopsychosocial model of pain. In 1987 Maslow devised the concept of 'whole person care' and described a 'hierarchy of

needs', which incorporates mind, body and soul[32]. This idea seems to fit neatly as a management plan to target all areas of the biopsychosocial model and is used widely in all aspects of modern healthcare.

Turk and Flor, in 1999, developed the model further to specifically apply to pain[33]; they describe how trauma or pathology causes physiological changes leading to nocicpetion. These events cause a perception centrally which is exhibited as a pain behaviour. Psychological processes and learnt or environmental responses have an impact at the perception and behavioural level, and there is a feedback loop, via deconditioning from pain behaviour, to the physiological processes involved. Herman and Flor have since further placed the emphasis more firmly on psychological and behavioural aspects by introducing a psychobiological model where pain is described only as a response and not a sensory phenomenon[29].

Today it is hard to find a paper published about pain that does not mention a biopsychosocial aspect of pain, however technical or pharmacological the topic. It is a concept familiar to all those involved in modern healthcare. In the 1970s it was hailed as a modern concept, a product of parallel advancements in physiology, pharmacology, psychology and sociology. However, the appreciation of the importance of psychological and environmental aspects in the aetiology and management of pain are not new.

The Ancient World, full of philosophical physicians, despite having only rudimentary understanding of physiology, described pain as an emotion associated with the tissue damage they observed. The holistic attitude of the time showed an appreciation of the interaction of psychological and physiological processes. As the dominance of the Church increased in Medieval Times, any anatomical and physiological knowledge gained by the ancients was forgotten. The mystery surrounding sin and pain was promoted, highlighting the importance of the psychosocial aspect of pain and it's management many centuries ago.

The separation of Church and State brought about by the Enlightenment caused an explosion of interest in the natural world and new neuroanatomical and physiological theories dominated pain research until the twentieth century. It was thought that the answer to curing pain lay in unravelling the secrets of the nervous system and that any psychological or environmental aspects should be actively ignored. Wartime and a growth in the evidence of the merits of psychological therapies forced pain physicians to look outside the physiological box in order to gain answers to unexplained areas of chronic pain.

Engel's 1977 model was not a modern concept but a culmination of many decades of illness theory. Its application to pain medicine is also not new, but an appreciation of how to best use it, is. Patients and physicians are now more willing to accept the concept than in the past. It is now widely

appreciated that pharmacology is not the only answer to the pain problem and that the aim of chronic pain management is not always cure, but more often, functional rehabilitation. The biopsychosocial model of pain continues to adapt, in line with the cultural and scientific beliefs of the day, as it has done for many hundreds of years.

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