ANALYSIS OF PAIN RELIEF IN EMERGENCY ROOM FOR ACUTE PAIN IN HOSPITAL UNIVERSITI SAINS MALAYSIA

by

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TO MY WIFE

A bouquet of thanks for bringing joy and colours to my life

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TABLE OF CONTENTS

Chapter 4. Result

TABLES

FIGURES

ABSTRAK

ANALISIS PENGURANGAN KESAKITAN DI JABATAN KECEMASAN HUSM UNTUK SAKIT AKUT.

OBJEKTIF

Objektif utama disertasi ini ialah untuk menilai rawatan ke atas pesakit mengalami sakit akut di Jabatan Kecemasan Hospital Universiti Sains Malaysia dengan menggunakan tahap kehilangan sakit semasa meninggalkan Jabatan Kecemasan.

METODOLOGI

Kajian prospektif ini menggunakan borang soal jawab yang telah diedarkan kepada 195 pesakit yang mengalami sakit akut (sakit yang bermula dalam jangka masa 24 jam). Kajian ini bermula dari bulan Disember 1999 sehingga Disember 2000. Jenis sakit, masa sakit, jenis ubat tahan sakit diberi, dan masa ubat diberi di Jabatan Kecemasan di analisakan. Tahap kesakitan diukur dengan menggunakan Skala Analog Visual. Skala sebelum dan selepas rawatan akan dicatat. Skala yang berukuran kurang dari 3.0 selepas rawatan akan dikira sebagai pengurangan sakit yang relevan. Kesan ke atas tekanan darah dan nadi dianalisa sebelum dan selepas rawatan. Data akan dianalisa dengan menggunakan "Two Tailed Test".

KEPUTUSAN

70% daripada pesakit yang menerima rawatan tidak mengalami pengurangan tahap kesakitan yang memuaskan walaupun analisa menunjukkan pengurangan "VAS" yang ketara ($p < 0.05$) sebelum dan selepas rawatan. Purata pengurangan tahap kesakitan

"VAS" ialah 3.31. Pesakit lelaki, sebab kesakitan yang tidak disengajakan dan kaum Melayu adalah faktor-faktor yang lebih cenderung kepada pengurangan kesakitan yang ketara. Keseluruhannnya, "non-steroidal anti-inflammatory drugs/NSAID" adalah analgesik yang paling popular digunakan oleh pegawai-pegawai perubatan. Analisa ini juga jelas menunjukkan bahawa nadi dan tekanan darah menurun selepas rawatan ($p<0.05$).

KESIMPULAN

Perubahan tekanan darah, nadi, dan perubahan psikologi pesakit dari segi tahap ketakutan, kesedihan, dan ketidakselesaan mesti diambil perhatian kerana faktor-faktor ini akan memberi kesan ke atas tahap kesakitan pesakit-pesakit. Buat masa ini bilik kecemasan kami tidak menganalisa kekuatan kesakitan. Analisis ini jelas menunjukkan bahawa penggunaan VAS adalah berkesan dan berpatutan.

Daripada keputusan analisis ini, beberapa perubahan telah dicadangkan:-

1. Semua staf-staf perubatan di bilik kecemasan mesti melengkapkan diri mereka dengan pengetahuan berkenaan analisa dan perawatan sakit akut termasuk cara-cara berkomunikasi secara berkesan dengan pesakit-pesakit tentang rawatan kesakitan.
2. Pesakit-pesakit sepatutnya diberi pengetahuan dan maklumat tentang cara-cara perawatan kesakitan yang boleh diperolehi di bilik kecemasan.
3. Pilihan analgesic yang lebih meluas mesti diberikan atau dibekalkan di bilik kecemasan.

4. Polisi-polisi berkaitan perawatan sakit akut mesti diwujudkan untuk kesemua pihak yang terlibat di dalam memberi rawatan kepada pesakit.

5. Penyelidikan yang lebih mendalam keatas perawatan sakit akut serta penggunaan analgesik di dalam kes-kes tertentu dan analisis ke atas kepuasan pesakit terhadap rawatan yang diterima mestilah digalakkkan di masa hadapan.

Secara amnya, perawatan sakit akut di bilik kecemasan HUSM masih tidak diberi perhatian yang teliti dan sewajarnya. Lebih banyak penyelidikan di dalam bidang ini di masa hadapan akan membantu menaikkan taraf perkhidmatan kesihatan yang diberikan kepada pesakit-pesakit yang berkunjung ke bilik kecemasan.

ABSTRACT

ANALYSIS OF PAIN RELIEF IN EMERGENCY DEPARTMENT HUSM FOR ACUTE PAIN

OBJECTIVE

The objective of this study is to assess acute pain management in Accident & Emergency Department Hospital Universiti Sains Malaysia in term of degree of pain relief on leaving the unit.

METHODS

A prospective observational study involving the use of questionnaires administered to 195 patients attending the Emergency Department HUSM with chief complaint of acute pain of any cause . Nature of pain, onset time, type of analgesia and time given by medical officer were assessed. The survey also incorporated the use of Visual Analogue Score (VAS) in the assessment of degree of pain relief during the stay in Accident & Emergency Unit . Any VAS score in excess of 3.0 cm was considered as moderate to severe pain and hence VAS score after treatment below 3.0 cm was taken as adequate pain relief. The effect on blood pressure and pulse rate were also analyzed before and after the treatment was given in the emergency room. The data were processed using two tail paired t test.

RESULTS

This study illustrated generally more than 70% of the patients presented to Emergency Department in HUSM did not gain adequate pain relief. Statistically there is significant VAS score change ($p < 0.05$) before and after treatment. The degree of pain relief varies with mean visual analogue score change of 3.31. Being male, accidental cause of injury and the Malay group showed more association with adequate pain relief as proven by the logistic regression & chi square tests. There is also tendency to use non-steroidal anti-inflammatory (NSAID) drugs (31.3%) more than any other drugs. The study had shown us that there were significant statistic changes in pulse rate and systolic blood pressure of the study group ($p<0.05$).

CONCLUSION

When assessing and managing acute pain in emergency room, not only objective assessment is important but also we have to look patient as a whole including the vital signs i.e. pulse rate, blood pressure and respiratory rate before and after treatment of acute pain. Currently no effective assessment tool is used to quantify acute pain in our emergency room and outcome from this study showed that visual analog scale is applicable in our setting because approximately 93% of selected patients were able to complete the Visual Analogue Scale.. The inclusion of pulse rate and blood pressure as part of pain assessment is also crucial and helpful to monitor acute pain relief and the effects of analgesics.

presence of tissue damage in the periphery.

After a peripheral injury a complex cascade of events is initiated. Several endogenous chemicals, including bradykinin, histamine, serotonin, products of the arachidonic acid cascade, and neuropeptides such as substance P, are released. Many of the chemicals that are released after injury are those substances that are involved in the process of inflammation. (Ohara, 1988). Prostaglandin and leukotrienes appear to act in concert with bradykinin to produce an enhanced activation of the primarey afferent terminal. The activation of the peripheral terminals results in the release of mediators of nociceptive transmission within the dorsal horn of the spinal cord, the next step in the processing of nociceptive information. (Taiwo and Levine, 1988). Bradykinin's effects in the periphery are specific and are mediated by B2-Bradykinin receptors, which are located on the terminals of primary afferent neurons. In addition to producing pain, bradykinin has many other effects, including an increased vascular permeability, which results in plasma extravasation and the formation of edema.

A synergy has been demonstrated between bradykinin and substance P in the production of plasma extravasation and pain.(Shabata et al.,1986). The excitation of the primary afferent also produces an axon reflex that results in the peripheral release on neuropeptides such as substance P, neurokinin A, and calcitonin gene related peptide (CGRP). These neuropeptides act on blood vessels to produce plasma extravasation. (Devillier et al.,1986). Activation of the primary afferent nerve terminals begins the transmission of nociceptive information. It is the release of nociceptive neurotransmitters from these primary afferent fibers that activates the second order

dorsal horn neurons. The activation of these neurons results in spinal reflex responses as well as the activation of ascending tracts, which transmit nociceptive information to supraspinal sites. Consistent with a role in nociceptive transmission, substance P has been localized to small diameter primary afferent fibers that terminate in the area of the substantia gelatinosa. Substance P and calcitonin gene related peptide had been shown to be a potent excitatory neurotransmitters on second order neurons in the dorsal horn. (Tuchscherer and Sybold, 1985).

The dorsal horn also receives central terminations of a variety of receptors in muscles, joints and viscera. Joint tissues have both myelinated and unmyelinated fibers, some of which respond selectively to noxious stresses. (Mense, 1981). It has been known for several decades that the neurons of the dorsal horn form laminar arrangements, with cells of particular morphology tending to reside in particular layers of the gray matter. We now know that different types of afferent fibers entering the dorsal horn also end in laminar zones so that they may contact only certain types of cord neurons. (Rexed et al., 1952). Nociceptive afferents terminate primarily in the superficial layers of the dorsal horn, and also in lamina 5. (Fitzgerald et al., 1984)

B) The Substantia Gelatinosa and Marginal Zone

The superficial layers of dorsal horn are translucent mainly because they lack myelinated fibers. Rexed lamina 2 and perhaps also lamina 1 are the equivalent of the substantia gelatinosa. These layers and to some extent the deeper layers of the dorsal horn, contain numerous tiny neurons that appear to synapse locally and receive a mixture of afferent inputs including the terminations of nociceptive fibers from the

periphery. (Dubuisson, 1993). Some of the lamina 1 neurons project to the thalamus and respond only to noxious inputs. Other lamina 1 cells are thought to have axons that ramify and terminate locally and do not project for long distances.Many lamina 1 cells contain opiod peptides such as enkephalin and dynorphin which is suprising given these cells' suspected role as pain transmission neurons. (Perl, 1980). It is increasingly evident that both large and small dorsal horn neurons may receive inputs not only from primary afferent fibers, which are predominantly excitatory, but also from neighbouring dorsal horn neurons, which may be excitatory, inhibitory, or both. The evidence that many of these neurons contain enkephalin and other neurally active peptides suggests that they may form a network of local interneurons which act at the junction of the primary afferent fibers and the larger cord neurons which send their axons to the brain.(Otsuka, 1990).

It has also been shown that the primary afferent fiber terminals within the substantia gelatinosa contain peptides such as substance P, vasoactive intestinal polypeptide, somatostatin, and an octapeptide similar to cholecystokinin which may simply be neurotransmitters. (Tiseo, 1990). The complex synaptic structures of the substantia gelatinosa include terminals of primary afferent fibers, terminals of local axons and dendrites, and terminals of brain stem neurons which descend to all levels of cords.

C) Ascending Projections From The Dorsal Horn

Ascending axons relevant to pain sensation travel in nearly all portions of the spinal cord white matter, in several discrete systems. Traditionally we have been taught that the transmission of all information about painful event takes place in the spinothalamic tract. Instead we now know that some information about noxious stimuli travels rostrally in the spinocervical tract, in the dorsal columns where some 15 percent of axons originate from dorsal horn neurons forming a second order pathway, and also in the crossed and uncrossed spinoreticular pathways which transmit from the dorsal horn to the brain stem reticular formation. (Brown, 1981). In primates, dorsal horn neurons giving rise to spinothalamic tract fibers are situated mainly in laminae 1 and 5 to 8. It appears that axons reaching the lateral thalamus, including the ventral posterolateral nucleus, tend to originate from layers 1 and 5 of the spinal cord whereas axons of spinoreticular neurons originates from laminae 7 and 8. Some of the spinoreticular tract projections are ipsilateral whereas the spinothalamic tract is predominantly a crossed pathway. (Willis, 1973). Spinocervical tract neurons, which send their axons rostrally to the lateral cervical nucleus at the cord brain stem junction are typically situated in layer 4 whereas those of dorsal column postsynaptic system are often located in laminae 3 and 4. (Brown, 1981). The brainstem and thalamic regions which receive information from these ascending systems project extensively to other diencephalic and forebrain structures, including the cerebral cortex and the limbic system. In addition to their alerting function, these ascending systems may in turn trigger descending control. (Talbot, 1991).

D) Control of Spinal Sensory Neurons By The Brain Stem and Spinal Cord

At spinal level, transmission may be modulated by either inhibiting the release of neurotransmitters from primary afferent fibers or inhibiting the activation of second order dorsal horn neurons. The source of spinal modulation may either be intrinsic or descend from supraspinal site. The dorsal horn of the spinal cord contains receptors for μ, κ, δ opiod receptors. These receptors are located presynaptically as well as postsynaptically on second order neurons. The inhibitor effects of opiod on the evoked release of substance P have been demonstrated in vivo. (Go and Yaksh, 1987). Evidence for postsynaptic as well as presynaptic action of spinal opiods has been reported. Opiod agonists will inhibit the firing of second order neurons in dorsal horn. (Sabbe and Yaksh, 1990). The antinociceptive properties of Gamma Aminobutyric Acid (GABA) may seve to modulate segmentally the firing of second order dorsal horn neurons. The use of the GABA B receptors selective agonist baclofen as an analgesic may be associated with its ability to inhibit other spinal reflex pathway. (Sawynok, 1987). The adrenergic system has also been shown to play a role in the modulation of nociceptive information. α adrenergic ligands are found in the substantia gelatinosa and activation of α2 receptors directly suppresses the activity of dorsal horn neurons. Also noradrenergic agonists have been shown to inhibit the evoked release of substance P. (Fleetwood et al, 1985). In laboratory animals and humans, electrical stimulation of the midbrain periaqueductal gray matter can produce impressive analgesia. Electrophysiological studies demonstrated that this type of stimulation directly activates medullary neurons which project axons to all levels of the spinal cord and that it suppresses the responses of spinothalamic tract neurons in the cord. (Kumar et al, 1990 & Willis et al, 1977). Stimulation of brain stem analgesia producing areas enhances the

activity of some neurons in the substantia gelatinosa. The analgesic effects of brain stem stimulation may outlast the actual period of stimulation in humans, and this phenomenon is sometimes matched by a similar prolonged period of alteration of cord cell activity. (Dubuisson, 1979). Stimulation produced analgesia in the central nervous system involves neurotransmitters such as serotonin and noradrenaline. Depletion of these substances had been shown to relate with reduction of analgesia in regions of body caudal to the lesion. (Basbaum, 1977)

2.5 CLINICAL, PHYSIOLOGICAL & BIOCHEMICAL EFFECTS OF ACUTE PAIN ON BODY SYSTEM

2.5.1 Heart

Sympathoadrenal and neuroendocrine responses may have a major impact on myocardial oxygen supply and demand. Catecholamine induced tachycardia, enhanced contractility, and increased afterload are well characterized determinants of increased oxygen demand. Increase oxygen demand may precipitate ischaemia and acute cardiac failure especially in patients with poorly compensated coronary artery and valvular heart disease. (Ellis et al, 1991). Other causes of reduced oxygen supply include 1) coronary artery constriction secondary to high circulatory levels of catecholamines and increased coronary sympathetic tone; 2) stress induced increases in plasma viscosity and platelet induced occlusion; and 3) release of secretion after platelet aggregation, which may initiate coronary vasospasm. (Willerson et al., 1989). Myocardial oxygen supply may be diminished as a result of pulmonary dysfunction, particularly in atelectasis secondary to pain-induced hypoventilation, and pulmonary edema resulting from stress- induced hypervolemia. (Breslow, 1990).

2.5.2 Lung

Pulmonary function may be dramatically altered by multiple trauma to the body. Atalectasis, aspiration pneumonia, and arterial hypoxemia are common post trauma complications whose incidence approaches 70% in severely traumatized patients. Such complications have been related to significant reductions in vital capacity (VC), functional residual capacity (FRC), and a reduced ability to cough and clear secretions. VC is the first pulmonary parameter to change in trauma to abdomen and chest. Reductions in VC, FRC, and forced expiratory volume in 1 second (FEV 1) are greatest soon after trauma to these areas of the body as the patient will not be able to inhale properly due to pain or losing consciousness. Other factors influencing the magnitude of VC reduction include diaphragmatic injury and history of chronic obstructive airway disease.

2.5.3 Peripheral Vascular System

Inadequately controlled pain may predispose patients to the development of deep venous thrombosis (DVT) and life threatening complications of pulmonary embolism after trauma. Catecholamines and angiotensin released in reponse to trauma stress may result in platelet-fibrinogen activation and the development of a hypercoagulable state. Severe pain is commonly associated with an impaired ability to ambulate and decreased venous flow. (Cousins, 1989). Trauma and injury to upper and lower limbs may damage venous conduits that return blood from the extremities. These factors make up Virchow's triad of hypercoagulability, venous stasis, and endothelial injury, which underlies the development of DVT.

2.5.4 The Stress Response

The pattern of biochemical changes following traumatic injury, sepsis, and surgery is known as the stress response. Stimulation of the peripheral, central (CNS) and autonomic nervous systems and release of humoral factors, such as kinins, leukotrienes, and prostaglandins, from tissue injury, produce these changes. Catecholamines, cortisol, glucagon levels increase, as do vasopressin, growth hormone, and beta endorphin level. The magnitude of the hormonal changes is roughly proportional to the extent of trauma. The increased in the catabolic hormones produce an altered endocrine/metabolic state characterized by hyperglycaemia, insulin resistance, increased gluconeogenesis, increased metabolic rate, sodium and water retention and protein catabolism. An impaired immune response also may be observed, characterized by a reduction in the number and function of lymphocytes and by granulocytosis.

2.6 PAIN MEASUREMENT AND ASSESSMENT

Clinical pain is a persistent, unbearable personal experience that is often uncontrollable and accompanied by a level of stress or depression, often incapacitates physically and emotionally, and can totally disrupt and overwhelm the behavior of sufferer. It prevents coherent thought and drives patients to seek treatment or relief from the pain. Acute pain differs from chronic pain, not just in duration and intensity or the fact that acute pain is more closely linked to identifiable pathology, but because noxious stimulus is more readily identifiable. (Peter, 1993).

Pain consists of four components, namely nociception, sensation, suffering, and behaviour. The actual perception of this state is based on a whole lists of modifiers

ranging from the memory of previous painful events to psychological influences including a state of stress, an alteration in mood, and an expectation of treatment and recovery. (Fordyce, 1978). There is little consensus and less empirical basis from which to choose the most appropriate instrument of pain measurement. Pain measurement is in evolution. It is often impossible to examine the relationship between nociception and the pain response since in certain condition the pain stimulus is absent. Consequently, to assess the pain experience, measurement instrument have traditionally relied upon subjective reporting, focusing on sensation, suffering, and behavior rather than on nociception. (White, 1993). The uniqueness of pain as it varies among individuals makes its objective measurement very difficult. Accurate measurement is of great importance, however, when one is attempting to assess the efficacy of analgesic therapy. Physicians and nurses involved with the daily care of patients in pain frequently misjudge pain intensity and effectiveness of pain medications. The "observer" pain scores (i.e nurses and physicians) frequently underestimate pain intensity but overestimate the effectiveness of pain medications. (Choiniere et al, 1990).

Clinician and nurse observer pain scores are based on behavioral and autonomic signs, which have been shown to be unreliable indices of pain intensity. Autonomic changes may result from the mere anticipation of pain or reflect unrelated patient anxiety. Behavioral signs are often coloured by cultural responses, emotional status, and psychological variability. (Choiniere et al, 1990)

Pain Assessment Tools:-

a) The single most reliable indicator of the existence and intensity of pain and

any resultant distress is the patient's self-report.

b) Self-report measurement scales include numerical or adjective ratings and visual analogue scales.

c) Tools should be made reliable, valid, and easy for the patient and the nurse or doctor to use. These tools may be used by showing a diagram to patient and ask the patient to indicate the appropriate rating. The tools may also be used by simply asking the patient for verbal response (eg. Mild, moderate, severe or unbearable).

d) Tools must be appropriate for the patient's developmental, physical, emotional, and cognitive status.

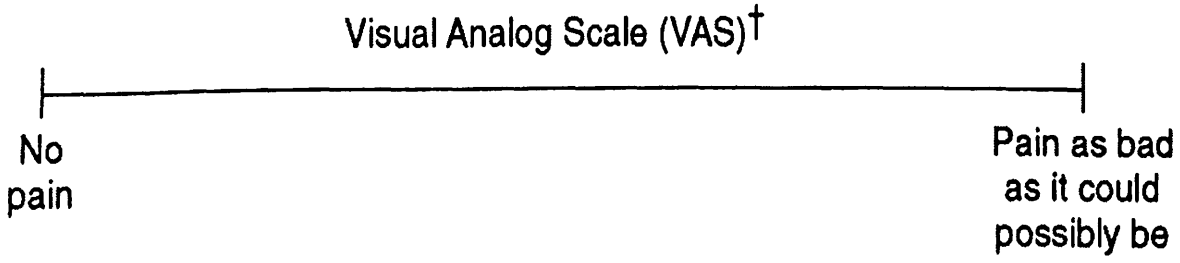
e) Patients who may have difficulty communicating their pain require particular severely emotionally disturbed, children and the elderly who do not speak English, and patients whose level of education or cultural background differs significantly from that of their health care team.

f) Unexpected intense pain, particularly if sudden or associated with altered vital signs such as hypotension, tachycardia, or fever, should be immediately evaluated, and new diagnoses should be considered

2.6.1 Visual Analogue Scale (VAS)

The Visual Analogue Scale (VAS) is a very useful pain assessment tool. It is extremely simple, sensitive, and reproducible instrument that allows patients to express the severity of pain as a numerical value. The VAS can be performed quickly, with minimal patient distraction, and can easily be adapted to individual situations. In addition to measuring the level of pain, it can also be used to measure other subjective variables

such as nausea, pain relief, and patient satisfaction. (Bercker and Hughes, 1990). The VAS is represented as a straight line, usually 10cm in length. At either end of the line are two poles or " anchors " that are defined as the extreme limits of the sensation or response to be measured. For example, the words "no pain" appear on the extreme left of the continuum, whereas "worst possible pain" is indicated on the extreme right. Patients are instructed to draw a single line intersecting the VAS at a point that depicts their perceived level of pain at that particular moment. From this marking, a concrete measurement, in either millimeters or centimeters, can be obtained and used for analysis. (**Figure 2.1)** (Holm et al, 1989).



(Figure 2.1)

The VAS type of measurement has the advantage of simplicity. It is widely used and is independent of language. It is easily understood by most patients and can be readily reproduced on successive presentations. It is readily sensitive to a change in pain level when assessing the value of specific treatment. It is far more accurate than a verbal category scale of pain relief which has insufficient words of ascending severity to critically grade pain relief. (Onhaus, 1975). The disadvantage of this instrument is that it treats the pain experience as if it were mono-dimensional. It emphasizes intensity without due regard to other factors. There tends to be a grouping at the center numbers with greater reproducibility at the extremes of the line and at the midpoint. (Huskisson

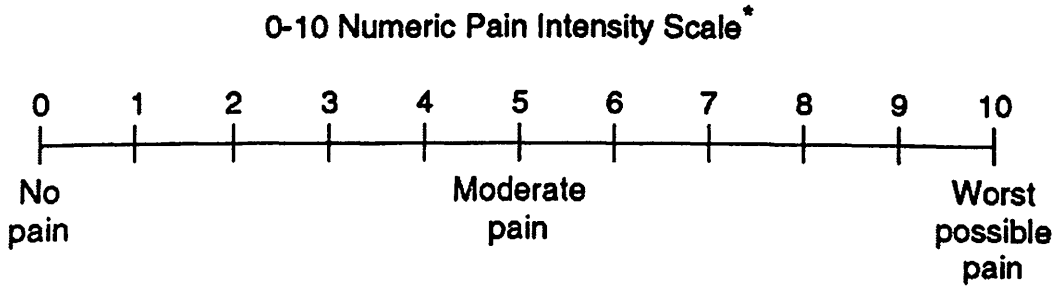
,1983). Another criticism is that the scale imposes limits by making the extremes absolute. Although "no pain" or "complete relief" is indisputably an absolute measure, the other anchor is not. The "worst pain one can imagine" leaves no room for even worse pain at later time. Not all patients can complete VAS, there being a quoted failure rate of 7 percent. It requires a certain amount of visual and motor coordination, which may be lacking in the severely stressful patients presenting in emergency room. (Scott, 1976).

Although the VAS is easy to use, it is essential to ensure complete patient understanding. Even the simplest concepts can be misunderstood, especially when people are placed in stressful situations. Whenever possible, it is advisable to instruct the patient in its use during preadmission to limit any confusion and thereby improve the reliabilty of the results. This form of measurement should be presented with minimal verbal and no finger-position cues, which can easily compromise accuracy. Accuracy can be further improved by having the scale presented by the same caretaker and should always be introduced with an appropriate statement standardized before experiment, such as "Please mark on the line the intensity of pain you are experiencing at this moment." (Chapman and Syrjala, 1985).

2.6.2 Verbal Pain Scales

I. Verbal numerical scale (VNS)

The VNS is a simple verbal pain rating scale with similarities to the VAS. It is linear and shows good correlation with the VAS over its full range. The VNS is easily understood by the patient who merely chooses a number between zero and 10 to represent the level of pain. (**figure 2.2**). (Murphy, 1988)



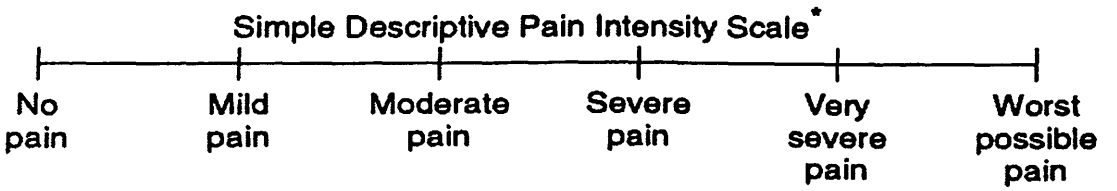
(Figure 2.2)

The VNS eliminates the need for visual and motor coordination required to complete the VAS and is more likely to be completed. Failure to complete the score is of the order of 2 percent.

II. Verbal Rating Scale (VRS)

The verbal type of scale is the simplest and most likely to be completed because patients prefer verbal scales to the visual analogue or numerical rating scales. Scales of defining pain intensity as mild, moderate, severe, or absent, or no pain, mild, discomforting,

distressing, horrible, and excruciating. The verbal scale is limited because it offers a restricted choice of words that represent pain and therefore does not allow for finer pain assessment (**Figure 2.3**) (Kremer et al, 1980)



(Figure 2.3)

Pain is the clinical symptom most difficult to evaluate. Banos JE et al had studied the acceptability of visual analogue scales in the clinical setting comparing it with verbal rating scales in postoperative pain. The results obtained showed that a high correlation between VRS and VAS could be established in all patients (p less than 0.001) (Banos et al, 1989). Price DD et al compared mechanical visual analogue scale and simple numerical rating scale for their capacity in pain measurement. Both scales provided consistent measures of experimental and clinical pain intensity but the ease of administration and scoring in clinical setting with visual analogue scale offer the possibility of a simple yet powerful pain measurement technology in both research and health care settings. (Price et al, 1994). Kremer et al reported that the patient preference on 3 types of pain intensity scale, namely the visual analogue scale (VAS), numerical and adjectival scales does not confound pain measurement.

According to Collins SL et al, one way to ensure adequate sensitivity for analgesic trials is to test the intervention on patients who have established pain of moderate to severe