An important component of effective postoperative pain management is a measure of the patient's pain intensity. This article examines three unidimensional pain measurement instruments and one multidimensional pain measurement instrument used in daily practice and clinical research. The strengths and weaknesses of the numerical rating scale, verbal descriptor scale, visual analogue scale, and the McGill Pain Questionnaire are discussed. Issues of validity and reliability, important in clinical research, are also presented.

Key words: McGill Pain Questionnaire, pain measurement, postoperative period, visual analogue scale.

Introduction
An important component of effective postoperative pain management is a measure of the patient's pain intensity. The personal nature of pain complicates its measurement and necessitates reliance on instruments which equate subjective feedback with objective data. This article examines pain measurement instruments routinely used in the evaluation of acute postoperative pain in the adult population.

Three unidimensional pain measurement instruments (those measuring only one dimension of pain) are discussed. One multidimensional pain measurement instrument, capable of measuring several facets of the pain experience, is also examined. The numerical rating scale (NRS), the verbal descriptor scale (VDS), and the visual analogue scale (VAS) comprise the unidimensional instruments; while the McGill Pain Questionnaire (MPQ) is the multidimensional instrument. The first two instruments find common use in daily practice; the latter two instruments, in clinical research.

Issues in pain measurement
Both the clinician and the pain researcher face three distinct challenges when attempting to measure pain. First, the pain experience must be viewed from the perspective of the patient. This is made difficult by both the patient and the clinician/researcher who brings his or her own unique perceptions and responses to the pain experience. What the patient describes is filtered through the
clinician's/researcher's understanding of pain based on his or her own prior experience. For example, the patient's description of pain in his broken leg is interpreted by the clinician/researcher through reference to a personal, usually different, suffering of pain—perhaps hurting a toe getting out of the shower. The clinician/researcher must always be aware of this unavoidable bias, as something is always lost in translation.

Next, both clinical and personal factors can dramatically influence the patient's perception of and response to pain. The type of pain, its duration, and its etiology, as well as any prior experience with the therapy employed in its management, are all clinical factors influencing the measurement of pain. Patient characteristics such as education level, nature of physical illness, gender, presence of affective disorders, visual ability, and ethnic background all have been shown to influence pain measurement in specific populations.3,7

Finally, only a limited number of pain measurement instruments are available that are quantifiable, reliable, and valid. Many researchers use ordinal measure Likert scales or interval measure visual analogue scales in an attempt to measure and quantify pain intensity. The major limitation of these unidimensional instruments is their questionable ability to measure the multidimensional aspects of pain. Each instrument possesses advantages and disadvantages when used either in daily practice or clinical research, which are discussed in this article.

Unidimensional instrument: Numerical rating scale

The numerical rating scale (NRS) is an instrument described by Downie in 1978 (Figure 1).8 The scale consists of a line oriented either vertically or horizontally. The number “0” is located on the bottom of the scale, if the vertical form is used, and on the left side of the scale, if the horizontal form is used. The number “10” is located on the top of the scale, if the vertical form is used, and on the right side of the scale, if the horizontal form is used. The patient is asked to rate his or her pain intensity on a scale of 0 to 10, with 0 indicating no pain and 10 indicating severe pain. The research is uncertain whether the horizontal or vertical form of an NRS offers greater accuracy. The decision to use a vertical or horizontal presentation may be as simple as determining patient preference. This method was employed in a study of pain assessment and plasma endorphin levels in burned children.9 However, once a vertical or horizontal format is selected, it

### Glossary

**Concurrent validity**: The degree to which scores on an instrument are correlated with some external criterion, measured at the same time.

**Construct validity**: The degree to which an instrument measures the construct (e.g., pain) under investigation.

**Discriminant validity**: An approach to construct validation that involves assessing the degree to which a single method of measuring two constructs yields different results (i.e., discriminates the two).

**Inter-rater reliability**: The degree to which two raters or observers, operating independently, assign the same ratings or values for an attribute being measured; such ratings normally occur in the context of observational research.

**Internal measure**: A level of measurement in which an attribute of a variable is rank ordered on a scale that has equal distances between points on that scale (e.g., Fahrenheit degrees).

**Likert scale**: A type of composite measure of attitudes that involves summation of scores on a set of items (statements) to which respondents are asked to indicate their degree of agreement or disagreement.

**Multidimensional instrument**: An instrument that measures more than one aspect of an attribute (e.g., intensity, affective, and sensory components of pain).

**Nonparametric statistics**: A general class of inferential statistics that does not involve rigorous assumptions about the distribution of the critical variables; most often used when the data are measured on the nominal or ordinal scales.

**Ordinal measure**: A level of measurement that yields rank orders of a variable along some dimension.

**Parametric statistics**: A class of inferential statistics that involves (a) assumptions about the distribution of the variables, (b) the estimation of a parameter, and (c) the use of interval measures.

**Predictive validity**: The degree to which an instrument can predict some criterion observed at a future time.

**Qualitative**: Information collected in the course of a study that is in narrative (nonnumerical) form, such as the transcript of an unstructured interview.

**Quantitative**: Information collected in the course of a study that is in a quantified (numerical) form.

**Reliability**: The degree of consistency or dependability with which an instrument measures the attribute it is designed to measure.

**Test-retest method**: A procedure used to determine the stability of measurements over time.

**Unidimensional instrument**: An instrument that measures one aspect of an attribute (e.g., intensity of pain).

**Validity**: The degree to which an instrument measures what it is intended to measure.

**Visual analogue scale**: A scaling procedure used to measure a variety of clinical symptoms (e.g., pain, fatigue) by having subjects indicate on a straight line the intensity of the attribute being measured.
should not be changed during the course of the study.

Although the NRS was originally published as a line with a scale of 0 to 10, multiple versions of this scale currently exist. This multiplicity of scales is the result of attempts to improve:

1. Ease of administration and scoring.
2. Rates of correct response.
3. Sensitivity of the scales.
4. Ability to detect treatment effects.

Some clinicians use a 0 to 5 scale, while others use a 0 to 10 scale. Visual cues may or may not be included. The latter type of scale is used as a measure of pain intensity at the author's institution in the postanesthesia care unit and in other patient care areas.

The NRS has several practical advantages over other pain measuring scales. The scale is simple to administer, easy to score, and readily administered in either written or verbal form. The scale can be used with non-English speaking patients through the appropriate substitution of the anchor words in the patient's native language. The majority of patients understand this scale, and it can be used to measure both the intensity of acute pain and the efficacy of analgesic therapy. Its chief disadvantage is its use at extremes of age. Impaired cognition is sometimes found in the elderly, and the inability of the very young to differentiate words and numbers may prohibit use of the NRS.

Unidimensional instrument: Verbal rating scale/verbal descriptor scale

Keefe first devised the verbal rating scale/verbal descriptor scale (VDS) and established its statistical validity and reliability. It was developed for assessing patient responses to analgesics. This scale consists of three to five numerically ranked words such as "none, slight, mild, moderate, and severe" describing the intensity of acute pain (Figure 2). The number corresponding to the word chosen is used to determine the intensity of pain at the time pain is evaluated. Clinicians can use the word or numeric value associated with it to assist in determining the present pain intensity and efficacy of analgesic interventions.

Use of the VDS offers the clinician some practical advantages over other pain measurement tools. The verbal descriptor scale is short, simple for the patient to complete, and easy for the practitioner to score and analyze. Moreover, the scale measures both acute and chronic clinical pain. However, the scale does artificially categorize the intensity of pain by forcing the patient to select a single word on the scale. Because pain is so subjective, the word selected may not reflect the patient's true sensation. This is a problem for both clinician and researcher, for anytime one tries to describe a continuum by means of a limited number of points, specific information may be sacrificed for general understanding.

Unidimensional instrument: Visual analogue scale

The visual analogue scale (VAS) is widely used by anesthesia providers when assessing the intensity of acute pain in clinical research. The VAS consists of a straight line, either vertical or horizontal, with verbal anchors at either end, representing a continuum of pain intensity. One end of the line has the anchor "no pain," while the other end of the line has the anchor "pain as bad as it could possibly be." The length of the line can vary but is often 10 cm (Figure 3). The patient is asked to make a single mark on the line indicating his or her present level of pain. The distance from the
The visual analogue scale (VAS) were first developed approximately 60 years ago to measure a variety of subjective phenomena, but the reference cited by most researchers who use VAS is that of Clarke and Spear. In pain research, VAS are generally used to measure the intensity of pain. The VAS usually consists of a line 10 cm long with verbal anchors at either end:

No pain

Pain as bad as it could possibly be

(Reprinted with permission from McGuire DB. Page 338.8)

left end of the line to the respondent’s mark is measured in millimeters, and this number is recorded. The VAS avoids the categorization of pain seen with visual descriptors, yet it produces more sensitive measurements, since subjects mark any point on the line between the two verbal anchors.

Traditionally the VAS was a horizontal scale, but recently it has been used as a vertical scale. To date, research is not conclusive regarding the comparative validity of the horizontal and vertical scales. Scott and Huskisson demonstrated that although vertical and horizontal scales correlate extremely well to one another, scores on the horizontal scale tended to be slightly lower. These results were not statistically significant nor, in this author’s opinion, clinically relevant. However, other studies suggest that the vertical scale is more sensitive, produces higher scores, and is easier for subjects to use. As with the NRS, the decision to use a VAS with vertical or horizontal presentation may be based more on patient preference and ease of use than on issues of sensitivity.

The advantages of the VAS are its simplicity of construction and ease of use. It avoids the pitfalls of language found in the VDS. Since the VAS uses few words, the vocabulary level of the subject is generally not a consideration. Patients with sight impairments can see it easily, especially if the anchor words are printed in large type, and patients medicated for pain frequently have sufficient manual dexterity to use the visual analogue scale. Finally, the VAS produces continuous level data (interval-level data) that is amenable to powerful, parametric-based tests.

Several disadvantages of the VAS must be noted. First, some patients have difficulty in converting the subjective sensation of pain to a straight line. Studies suggest that for this group of patients the visual descriptor scale is easier to use. However, many researchers and clinicians have overcome this difficulty by providing patients with additional verbal guidance on the use of the tool, as well as written instructions at the top of the scale. Second, the VAS must be given in a written form which involves two steps: the patient must mark the scale, and the clinician must measure the patient’s response. This second step can be a source of error if the clinician measures the patient’s response incorrectly. A second source of error may lie with the scale itself. Users must be careful not to photocopy the scale for clinical or research use, since the length of the 10-cm line may change slightly during the photocopying process, thereby providing numerous scales of various lengths. It is recommended that the VAS be printed if it is to be used as a research instrument. Third, some patients with severe visual impairment are unable to use the visual analogue scale regardless of the type size used for the anchor words. Finally, the VAS cannot be used to measure pain intensity over the phone. This may be important for chronic pain patients experiencing an exacerbation of their pain or for outpatient surgical patients. It is recommended that verbal descriptor or numeric rating scales be used in this patient population.

Multidimensional instrument: McGill Pain Questionnaire

The McGill Pain Questionnaire (MPQ) was formulated in 1971 in the work of Melzack and Torgerson. The full version, or long form, of the MPQ was published in 1975 and measures several dimensions of the pain experience: location of pain; pattern of pain over time; sensory, affective, and miscellaneous components of pain; and pain intensity (Figure 4). The MPQ has an abbreviated version, or short form, consisting of three parts. Part one measures the sensory and affective dimensions of pain. The other two parts of the questionnaire assess pain intensity (Figure 5).

The principal advantages of the MPQ are the wealth of research studies supporting its reliability and validity and the fact that it is a powerful tool for obtaining data on the quantitative and qualitative aspects of pain. It is one of the few instruments available that can successfully address the multidimensionality of pain.

Disadvantages of the MPQ follow. The long form version is complex, demands intense concentration from patients, and requires up to 30 minutes to complete. Each of these may be a problem for the very sick, poorly motivated, or uncomfortable patient. Furthermore, the busy practitioner often finds the 30-minute assessment time impractical. Additionally, some patients may have diffi-
Figure 4
The McGill Pain Questionnaire

Patient’s Name ___________________________ Date __________ Time __________ am/pm
PRI: S __________ A __________ E __________ M __________ PRI(T) __________ PPI __________
(1-10) (11-15) (16) (17-20) (1-20)

1 Flickering
Quivering
Pulsing
Throbbing
Beating
Pounding

11 Tiring
Exhausting

12 Sickening
Suffocating

13 Fearful
Frightful
Terrifying

14 Punishing
Gruelling
Cruel
Vicious
Killing

15 Wretched
Blinding

16 Annoying
Troublesome
Miserable
Intense
Unbearable

17 Spreading
Radiating
Penetrating
Piercing

18 Tight
Numb
Drawing
Squeezing
Tearing

19 Cool
Cold
Freezing

20 Nagging
Nauseating
Agnoring
Dreadful
Torturing

E = External
I = Internal

Comments:

S - Sensory
I

PRI = Pain rating index
PRI(T) = Pain rating index (total)
PPI = Present pain intensity

(After print permission from Melzack R. Montreal: McGill University.)

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The McGill Pain Questionnaire—short form

<table>
<thead>
<tr>
<th>Patient's Name:</th>
<th>Date:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>None</th>
<th>Mild</th>
<th>Moderate</th>
<th>Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Throbbing</td>
<td>0)</td>
<td>1)</td>
<td>2)</td>
</tr>
<tr>
<td>Shooting</td>
<td>0)</td>
<td>1)</td>
<td>2)</td>
</tr>
<tr>
<td>Stabbing</td>
<td>0)</td>
<td>1)</td>
<td>2)</td>
</tr>
<tr>
<td>Sharp</td>
<td>0)</td>
<td>1)</td>
<td>2)</td>
</tr>
<tr>
<td>Cramping</td>
<td>0)</td>
<td>1)</td>
<td>2)</td>
</tr>
<tr>
<td>Gnawing</td>
<td>0)</td>
<td>1)</td>
<td>2)</td>
</tr>
<tr>
<td>Hot-burning</td>
<td>0)</td>
<td>1)</td>
<td>2)</td>
</tr>
<tr>
<td>Aching</td>
<td>0)</td>
<td>1)</td>
<td>2)</td>
</tr>
<tr>
<td>Heavy</td>
<td>0)</td>
<td>1)</td>
<td>2)</td>
</tr>
<tr>
<td>Tender</td>
<td>0)</td>
<td>1)</td>
<td>2)</td>
</tr>
<tr>
<td>Splitting</td>
<td>0)</td>
<td>1)</td>
<td>2)</td>
</tr>
<tr>
<td>Tiring-exhausting</td>
<td>0)</td>
<td>1)</td>
<td>2)</td>
</tr>
<tr>
<td>Sickenning</td>
<td>0)</td>
<td>1)</td>
<td>2)</td>
</tr>
<tr>
<td>Fearful</td>
<td>0)</td>
<td>1)</td>
<td>2)</td>
</tr>
<tr>
<td>Punishing-cruel</td>
<td>0)</td>
<td>1)</td>
<td>2)</td>
</tr>
</tbody>
</table>

No Pain - Worst Possible Pain

Present pain intensity

0 | No Pain
1 | Mild
2 | Discomforting
3 | Distressing
4 | Horrible
5 | Excruciating


culty understanding certain word descriptors or applying them to their experience of pain. The latter may pose a problem across cultural groups or subgroups.8

Psychometrics

The visual description scale and the visual analogue scale have been compared, and issues of sensitivity of measurement, validity and reliability, ease of patient use, and patient preference have been examined (Table I). Most researchers and practitioners agree that these scales objectively measure the intensity of pain and correlate well with each other.23–24 Some studies suggest that subjects prefer the five adjective verbal descriptor scale and that the utility of the scales varies according to patient characteristics and the clinical context in which the scales are used.25, 26

The McGill Pain Questionnaire has been used to establish the concurrent validity of the visual analogue scale.27 Discriminant validity of the VAS has also been demonstrated, while the reliability of the VAS has been demonstrated using a variety of techniques.28 Test-retest methods demonstrate that subjects are able to reliably repeat measures of subjective sensations.29, 30 Ratings repeated after 1 hour have higher reliability coefficients than those rated after 2 weeks.31 Some researchers have found that intensity of experienced sensations influences their replication on the VAS. Subjects are better able to reproduce marks near the extreme ends of the scale rather than those in the middle of the scale.32 Finally, interrater reliability was found to be adequate.33 The VAS is a more sensitive measure of subjective sensations than a graphic rating scale or a four-point rating scale.34

The MPQ has undergone numerous studies examining its validity and reliability. Reliability has been demonstrated across many groups of subjects, including cancer patients,24, 35 subjects of experimentally induced pain,36 and patients with a wide variety of medical and surgical diagnoses.22 Construct, concurrent, and predictive validity have been supported in a variety of studies.37–42 This research suggests that the MPQ is a reliable and valid measure of the multidimensional aspects of pain that can be used across a wide variety of patient groups with diffuse types of pain.

Conclusions

When selecting an instrument for the measure of pain, the anesthetist must consider what dimension of pain is to be measured. For example, an instrument to measure pain intensity and the efficacy of analgesic intervention may differ considerably from a tool needed to measure the multidimensional aspect of acute postcesarean section pain. For researchers, the research goal or question has an impact on the selection of an instrument: the tool must mesh with the measurement goals. Another consideration of instrument selection is the type of pain being studied. Finally, characteristics of the patient population under study must be addressed. Individual patient characteristics, such as visual and hearing ability, motor coordination, type of pain, and educational level, to name a few, will have an impact on the patient’s ability to complete specific instruments.

The daily use of pain measuring methods guides our approach to pain management. The NRS and VDS are two instruments that can be employed at the bedside. The VAS and the MPQ are more complex instruments that provide the clinician and researcher with additional data about the multidimensionality of pain. The use of basic pain measurement instruments can assist the nurse.
anesthetist in the quantification of pain and thereby provide baseline data for further intervention.

REFERENCES


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**Table I**

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Dimension(s) measured</th>
<th>Reliability</th>
<th>Validity</th>
<th>Type of pain best suited for</th>
<th>Ease of understanding</th>
<th>Time required for explanation &amp; administration</th>
<th>Time required for scoring</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Intensity</td>
<td><strong>Good</strong></td>
<td><strong>Probable</strong></td>
<td>Clinical</td>
<td>Very easy</td>
<td>&lt;5 minutes</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- Acute</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- Chronic</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- Progressive</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>McGill Pain Questionnaire</td>
<td>Location</td>
<td><strong>Good</strong></td>
<td>Good</td>
<td>Clinical</td>
<td>Moderately easy to</td>
<td>15-30 minutes</td>
<td>5-10 minutes</td>
</tr>
<tr>
<td></td>
<td>Sensation</td>
<td></td>
<td></td>
<td>- Acute</td>
<td>very difficult</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Affective aspects</td>
<td></td>
<td></td>
<td>- Chronic</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Evaluation</td>
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<td>- Progressive</td>
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<td></td>
<td>Pattern</td>
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</table>


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**AUTHOR**

Stephen A. Flaherty, CRNA, MS, is a graduate of the Anesthesia Nurse Practitioner Program, Rush University, Chicago, Illinois. He currently practices at Rush-Presbyterian-St. Luke's Medical Center in Chicago. Active at both the state and national level, Mr. Flaherty serves on the Illinois Association of Nurse Anesthetists Board of Directors and has served on the AANA Practice Committee (1993-1994 and 1994-1995). In addition to clinical and didactic teaching assignments in the Nurse Anesthesia Program at Rush, Mr. Flaherty is also a doctoral candidate in the Rush University College of Nursing.

**ACKNOWLEDGMENTS**

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Sevoflurane is indicated for induction and maintenance of general anesthesia in adult and pediatric patients for inpatient and outpatient surgery.

**CONTRAINDICATIONS**

Sevoflurane should be administered only by persons trained in the administration of general anesthesia facilities for the management of the patient airway, artificial ventilation, oxygen enrichment, and circula
tory resuscitation must be immediately available. Since levels of anesthetic concentration can be rapidly and unpredictably reached at predictable concentrations of sevoflurane should be used.

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Treatment of malignant hyperthermia includes discontinuation of triggering agents, administration of intravenous dantrolene sodium, and alkali administration (Appendix B). Protection against ingestion of Compound A is provided with oxygen enrichment for additional information on patients during general anesthesia should be monitored and sustained if possible. Sevoflurane may present an increased risk in patients with known sensitivity to volatile anesthetics.

**PRECAUTIONS**

During the maintenance of anesthesia, increasing the concentration of sevoflurane, production of Compound A, and the recovery from general anesthesia should be assessed carefully before a patient is discharged from the post-anesthesia care unit. Sevoflurane is indicated for induction and maintenance of general anesthesia in adult and pediatric patients for inpatient and outpatient surgery.

**DOSAGE AND ADMINISTRATION**

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