Facial expression to discriminate between pain and absence of pain in critically ill intubated adults during painful procedures

M. R. Arif and M.J. Grap
School of Nursing, Virginia Commonwealth University, Richmond, Virginia, marif@mcvh-vcu.edu

Purpose

To describe the evidence of behavioral and biological markers related to facial expression in non-communicative critically ill patients experiencing pain during procedures.

Research Questions

What is the empiric evidence of the relationship of facial expressions to the experience of pain in the critically ill?

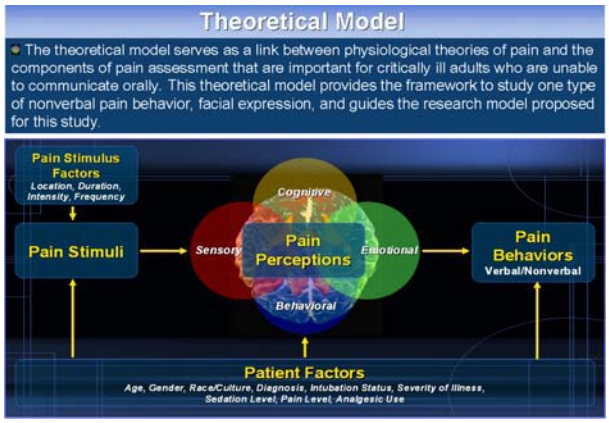


Figure 1. *Theoretical model*

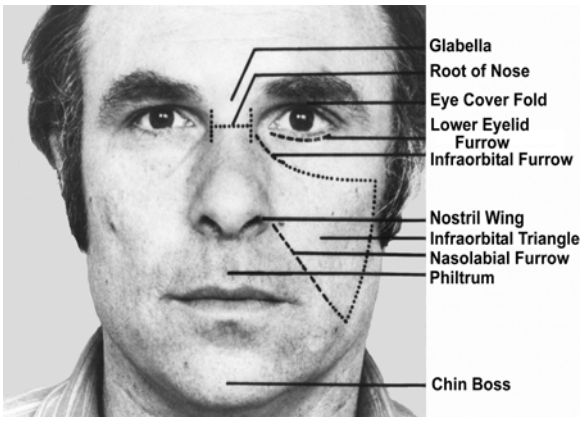
Background

Pain is a complex multidimensional concept that is difficult to define. Individual pain experiences influence cognitive, emotional, and behavioral responses (Figure 1). Pain assessment is a significant challenge in critically ill adults, especially those who are unable to communicate their pain level. In critical care many factors may alter oral communication including tracheal intubation, reduced level of consciousness, use of restraints, sedation, and paralyzing drugs. These patients are more likely to receive inadequate analgesics than those who are able to communicate, but just as likely to experience painful illnesses. The need for optimal pain assessment in adult critical care settings is essential since it has been reported that 35% to 55% nurses underrate the patient's pain [1-3]. and in one study 63.6% of patients did not receive any medications before and/or during painful procedures [4].

Furthermore, unconscious or sedated patients cannot communicate their level of pain using numeric pain rating scales (NRS) (0-to-10) and are therefore at risk for being inadequately medicated for pain [5-6]. Inaccurate pain assessments and resulting inadequate treatment of pain in critically ill adults can lead to significant physiologic consequences such as increases myocardial workload which can lead to myocardial ischemia, or impairs gas exchange causing a cascade of events which can lead to pneumonia [7]. The first step in providing adequate pain relief for patients is systematic and consistent assessment and documentation of pain. Identification of the optimal pain scales for non-communicative patients have been the focus of several studies. To date, however, no one pain assessment tool is universally accepted for use in the non-communicative patient. A common component of behavioral pain tools is evaluation of

Figure 2. *Using The Observer XT 7.0 to code facial action units*

facial behaviors. Although use of facial expression is an important behavioral measure of pain intensity, precise and accurate methods for interpreting the facial expression of pain has not been empirically evaluated in critically ill, non-communicative patients.



Findings

The face reveals a wealth of information about human behavior. The most frequently used pain behavior in pain evaluation scales for patients who cannot orally communicate is facial expression. Facial expression has been studied for centuries, dating back to Charles Darwin's "The Expression of Emotions in Man and Animals"[8] reporting observations of why particular facial expressions occur with particular emotions. Ekman and Friesen, pioneers of the Facial Action Coding System (FACS), identified 6 universal facial expressions [9]. They demonstrated that observers judgments of anger, disgust, fear, sadness, happiness and surprise made by preliterate people as isolated as New Guineans were no different than judgments made by college students in eight literate cultures around the world [10]. Patients who are unable to orally communicate due to altered mental status, sedation, unconsciousness, or cognitive impairment have been observed to show facial expression during painful stimuli [11-12]. Facial expressions provide an important behavioral measure for the study of emotion, cognitive processes, and social interaction. Use of facial expression is also an important behavioral measure of pain intensity, but precise and accurate

methods for interpreting facial expressions of pain in non-communicative critically ill adults has not been identified.

Facial expression in pain

Facial expression specific to pain has been studied using the Facial Action Coding System (FACS). These include lowered brows, raised cheeks, tightened eyelids, a raised upper lip or opened mouth, and closed eyes. Craig and Patrick [13] used the FACS to identify six facial activity associated with exposure to noxious stimulus (AUs 6-7-cheek raise, lids tight; 10-upper lip raise;12-lip corner pull; 25-lips part; 26-27-jaw drop-mouth stretch; and 43-45-eyes closed-blink). Prkachin [14] focused on pain behavior of adults during three pain stimulus (electric shock, cold, pressure, and muscle ischemia). He found 4 actions evident with pain, increasing in intensity/duration: brow lowering (AU4), tightening and closing of the eye lids (AU6/AU7), and nose wrinkling/ upper lipraising (AU9/AU10).

Key Variables and Their Measurements

Variable	Measure	Measurement Interval
Demographic Factors	Age, Gender, Race/Ethnicity/, Diagnosis, Intubation Status	Once at time of study enrollment
Facial Expression	Facial Action Coding (FAC) Facial EMG	Continuously for 1 hour video recording Continuously for 1 hour
Severity of Illness	APACHE III	Once at study enrollment, based on last 24 hours of data
Level of Sedation	PSI RASS	Continuously for 1 hour Pre procedure and post procedure
Level of Pain	BPS	Pre procedure and during procedure
Sedative/Analgesic Use	Amounts converted to equivalent units (mg) of fentanyl and lorazepam, based on relative potency	Once prior to noxious procedure for the previous 4 hours

Figure 3. *Key variables and measurements*

Methods

This descriptive research design will be conducted in 933-bed tertiary care university medical center. Sample of 100 subjects will be recruited Surgical Trauma ICU and Medical Respiratory ICU who are non-communicative. Key variables and their measurements are listed in Figure 3

Facial Expression will be measured using the Facial Action Coding System with slow action video and stop-frame feedback. The basic elements of FACS are 44 action units (AUs). Each AU represents the movement of a single facial muscle or a group of muscles, which move as a unit. FACS has been integrated in a recent new application of scoring facial expressions with the use of The Observer XT 7.0 software (see Figure 2). This The Observer XT allows for synchronized recording and playback of four full-resolution media files, physiological data, and EMG.

Facial muscle activity will be measured using electromyography (EMG). The EMG signals will be recorded and processed by a MyoSystem 1200 (Noraxon, Inc., Scottsdale, AZ) instrument. EMG recordings are beneficial because of their higher temporal resolution and the ability to register EMG activity automatically and continuous over an extended period of time, as well as the objective evaluation of EMG signals.

Discussion

Facial expressions provide an important behavioral measure for the study of emotion, cognitive processes, and social interaction. Use of facial expression is an important behavioral measure of pain intensity, but precise and accurate methods for interpreting facial expressions of pain in non-communicative critically ill adults has not been identified. The goal of this presentation is demonstrate use of biobehavioral technology such The Observer XT tool for recording and analyzing behaviors measured by FACS, EMG, and other physiological data.

References

1. Hamill-Ruth, R. J. & Marohn, M. L. (1999). Evaluation of pain in the critically ill patient. *Crit Care Clin.,* **15**, 35-vi.
2. Puntillo, K. (1997). Stitch, stitch..creating an effective pain management program for critically ill patients. *AmJ.Crit Care, 6,* 259-260.
3. Puntillo, K. A. (1990). Pain experiences of intensive care unit patients. *Heart Lung,* **19**, 526-533.
4. Puntillo, K. A., Wild, L. R., Morris, A. B., Stanik-Hutt, J., Thompson, C. L., & White, C. (2002). Practices and predictors of analgesic interventions for adults undergoing painful procedures. *Am.J.Crit Care,* **11**, 415-429.
5. Hall-Lord, M. L., Larsson, G., & Steen, B. (1998). Pain and distress among elderly intensive care unit patients: comparison of patients' experiences and nurses' assessments. *Heart Lung, 27,* 123-132.
6. Ferguson, J., Gilroy, D., & Puntillo, K. (1997). Dimensions of pain and analgesic administration associated with coronary artery bypass grafting in an Australian intensive care unit. *J.Adv.Nurs.,* **26**, 1065-1072.
7. McArdle P. (1999). Intravenous analgesia. Crit Care Clin. 14, 89-104.
8. Darwin, C. (1998). The expression of the emotions in man and animals / Charles Darwin ; with an introduction, afterword, and commentaries by Paul Ekman. (3 ed.) New York: Oxford University Press.
9. Ekman, P. & Friesen, W. V. (1978). *Investigator's guide to the Facial Action Coding System.* Palo Alto, CA: Consulting Psychologists Press.
10. Ekman, P., Friesen, W. V., O'Sullivan, M., Chan, A., acoyanni-Tarlatzis, I., Heider, K. et al. (1987). Universals and cultural differences in the judgments of facial expressions of emotion. *J.Pers.Soc.Psychol.,* **53**, 712-717.
11. Puntillo, K. A., Miaskowski, C., Kehrle, K., Stannard, D., Gleeson, S., & Nye, P. (1997). Relationship between behavioral and physiological indicators of pain, critical care patients' self-reports of pain, and opioid administration. *Crit Care Med.,* **25**, 1159-1166.
12. Puntillo, K. A., Morris, A. B., Thompson, C. L., Stanik-Hutt, J., White, C. A., & Wild, L. R. (2004). Pain behaviors observed during six common procedures: results from Thunder Project II. *Crit Care Med.,* **32**, 421-427.
13. Craig, K. D. & Patrick, C. J. (1985). Facial expression during induced pain. *J.Pers.Soc.Psychol.,* **48**, 1080-1091.
14. Prkachin, K. M. (1992). The consistency of facial expressions of pain: a comparison across modalities. *Pain,* **51**, 297-306.