POSTER DISCUSSION VIII

A1059

TITLE: MEDICAL DECISION MAKING: ARE THERE ANY RULES USED FOR DEFINING HEMODYNAMIC INSTABILITY?

AUTHORS: T.D. East, Ph.D.†, S. Henderson, BA†, N.L. Pace, M.D.*, A.H. Morris, M.D.†, J.X. Brunner, Ph.D.'

AFFILIATION: †Pulmonary Div.,LDS Hospital, 8th Avenue and C Street, Salt Lake City, UT 84143, *Anesthesiology Dept, Univ. of Utah, Salt Lake City, UT 84132, 'Hamilton Ventilators, P.O. Box 26, CH-7402, Bonaduz, Switzerland

Comprehending the way physicians make decisions is essential to the reduction and elimination of costly mistakes that impact patient safety. Knowledge engineering attempts to divine the underlying knowledge at work in every-day medical decision making. One approach to knowledge engineering is to carefully review how decisions were made in the past with the goal of extracting the rules. The purpose of this project was to use previously collected data from ICU patients to derive the rules for the definition of hemodynamic instability.

With approval of the Institutional Review Board, 97 ICU patients between 9/9/86 and 7/29/90 were included in the analysis. All of these patients had adult respiratory distress syndrom. Their mechanical ventilation was managed by a set of computerized protocols.[1] These protocols generate specific treatment instructions which have now been used for over 30,000 hours in 101 patients. If the clinician does not feel that the instruction is valid, the software will request them to choose a reason from a list. One of the reasons is hemodynamic instability. We retrospectively searched for instructions that were not followed due to hemodynamic instability. For each patient, we also chose one randomly selected therapy instruction which was followed to act as a control. For each instruction we then selected the closest corresponding hemodynamic data set within 2 hours prior to the instruction: Sys BP, Dia BP, Mean BP, Heart Rate, Mixed Venous Oxygen Saturation (S_vO_2), Cardiac Output (Qt), Pulmonary Artery Pressure (PA), and Pulmonary Artery Wedge Pressure (PAW). A stepwise logistic regression was used to determine the rules used for defining hemodynamic instability.

36 hemodynamic instabilities were noted in the 97 patients. S_vO_2, Qt, PA and PAW were measured only 30, 24, 58 and 58 percent of the time, respectively. It was felt that these variables did not contribute significantly to the decision making process and were excluded from further analysis. The table documents the mean and the standard error of the mean for each of the variables.

Hemo Status	Sys BP	Dia BP	Mean BP	HR
Stable	120±2.5	67±1.5	86±1.8	111±2.7
Unstable	119±4.6	66±2.7	85±3.2	113±2.4

The stepwise logistic regression was run with a removal limit of p>0.15 and an enter limit of p<0.10. The regression did not converge after 50 iterations.

Even with a well constrained problem where we had good data on the decision made by the clinician we found no central tendency in any of the variables that would indicate a rule for defining hemodynamic instability. We were surprised that variables we had considered important (S_vO_2, Qt, PA and PAW) were not even measured most of the time. We conclude that the decision making process used by physicians has great variation, both between and within physicians. We have found the best approach to generate rules to be an iterative approach in which a consensus group develops a set of computerized rules and they are tested in the ICU. This iterative process has enabled us to develop protocols associated with a significant increase in survival perhaps due to the reduction in the number of costly mistakes.

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References:

1. Morris AH, Réan Soins Intens Méd Urg, 1990; 6(7):485-490.

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TITLE: TASK ANALYSIS, VIGILANCE, AND WORKLOAD IN NOVICE RESIDENTS

AUTHORS: DM Gaba, MD, O Herndon, M Zornow, MD, M Weinger, MD, L Dallen, MD

AFFILIATION: Department of Anesthesia, Stanford University; Department of Anesthesiology, University of California, San Diego

Conducting anesthesia involves a complex set of tasks The distribution of tasks over time has not been studied in detail. Previous studies[1,2] suggested that workload and vigilance might be related to preoccupation with certain tasks, but the small number of task categories, and the large spectrum of case complexity and anesthesiologist experience precluded testing of this hypothesis. We studied the task distribution, vigilance and subjective workload of novice anesthesia residents, all within their first eight weeks of training, primarily during simple ambulatory surgical procedures.

Five residents, during 21 cases, gave informed consent for the study, as approved by the Institutional Review Board. During each case the following measurements were made: 1) Using a computer, an observer recorded the beginning of each new activity of the resident in one of 29 task categories (e.g. "recording"). When more than one activity was occurring the dominant task was recorded. 2) Every 5 minutes the resident was asked to rate his/her workload on a scale from 6= "no exertion" to 20= "maximal exertion." The observer also rated the resident's apparent workload on the same scale. 3) In 10 cases in which intubation took place.a red light was placed next to the ECG monitor, in clear view of the anesthesiologist. Three times in the 20 min. period surrounding intubation and then randomly every 10 - 20 min. until the end of the case the light was illuminated until the first evidence that the resident had seen it (verbal comment, gesture); the time delay was recorded. Giving the resident multiple response pathways allowed vigilance testing even when he or she was manually occupied. When a delay of > 2 min. occurred the activity of the resident during that time was specifically recorded.

For each case the task codes were plotted against case elapsed time. A measure of task density was derived from the number of new activities initiated each minute. The correlation between the self-perceived workload and the investigator perceived workload was determined using the non-parametric Spearman rank coefficient. The vigilance delay times were compared by ANOVA. Data are presented as mean ± standard deviation.

Four tasks accounted for 50.1 percent of resident time during the cases studied. Observing and adjusting monitors and recording were distributed evenly throughout the case elapsed time. As expected, tasks related to airway manipulation occurred primarily at the beginning and end of cases.

ACTIVITY	% OF TOTAL CASE TIME		
	Mean	Minimum	Maximum
Observe Monitors	17.95	9.05	30.1
Recording	13.33	0	20.43
Attending Conversation	13.28	1.76	35.44
Adjust Monitors	6.57	1.59	13.4
ALL OTHER TASKS	49.9	N/A	N/A

Subjective workload was assessed as equal by the residents and by the observer (Spearman rank coefficient = 0.96). Subjective workload did not vary with task density, but did appear to vary with specific task types. Airway management was associated with high subjective workload at the beginning and end of cases. Workload uniformly diminished during the maintanance phase of cases, and did not increase during conversation with the attending.

Visual vigilance delay was greater (p<0.004) in the peri-intubation" period (delay=157 ± 238 sec.) than in the "non-intubation" period (42 ± 59 sec.). Vigilance delay during all periods was markedly greater (p<0.001) when manual tasks (airway, line placement, etc.) were underway (400 ± 267 sec. vs. 34 ± 29 sec.).

Case management typically involves 4 phases: preparation, induction, maintenance, and emergence. The activities of the preparation, induction, and emergence phases account for a large portion of the workload of a case, but only a small fraction of the resident's total time. Manual tasks clearly preoccupied the resident's attention to visual stimuli. It is uncertain whether the residents would have been able to detect patient abnormalities appearing visually on monitor displays in such circumstances. Visual vigilance did not appear to be impaired during interactions with the attending.

For these residents we do not know whether the distribution of their activities, their perceived workload, or the impact of tasks on their visual vigilance will change as they become more experienced. These factors may be important markers of the development of a robust strategy for allocating attention which are a hallmark of the expert practice of anesthesia.

References:

1. Anesthesia and Analgesia 71:354-361, 1990
2. Anesthesiology 73:A498, 1990