

TITLE: MEASURING THE MENTAL WORKLOAD OF THE ANESTHESIOLOGIST
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"Mental workload" describes the load imposed on the cognitive resources of a human operator by the tasks encountered in the work environment. In aviation, workload is an important criterion for evaluating new cockpit designs and operational protocols.¹ We measured the anesthesiologist's mental workload using a standard paradigm termed the "subsidiary task methodology"² in which performance on a simple extra task is used to assess the subject's "spare capacity." When workload for the main task is high, spare capacity and performance on the subsidiary task decreases.

Informed consent (as approved by the local IRB) was obtained from 19 patients and the anesthesia resident assigned to their case (11 residents).

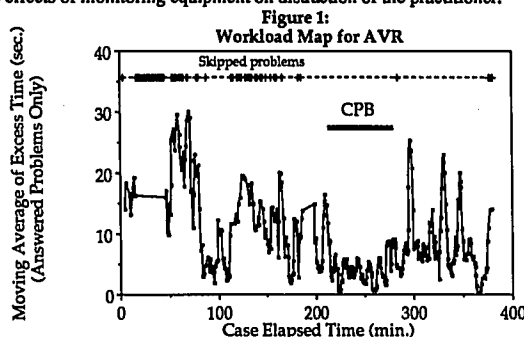
The subsidiary task consisted of adding 2 two digit numbers presented on the screen of a Macintosh computer. Subjects entered their answer using the keyboard. During a 5 min. baseline period subjects devoted complete attention to addition problems presented at 15 sec. intervals. Between the time the patient entered and left the OR problems were presented randomly every 40 - 50 seconds. A beep sounded when the problem was displayed. Patient care took absolute priority at all times. An observer continuously entered in the computer the subject's prevailing anesthesia activity (i.e. manual task, monitoring, attending, conversing, recording, no specific task). The time to respond, the error, and the prevailing activity were recorded for each problem. If the subject could not respond (too busy or could not manually enter the answer) a special code was recorded to indicate that the problem was "skipped."

Errors were infrequent (< 5% of answers) and were usually due to faulty keyboard entry. This analysis deals with time to answer and % of problems skipped. For each subject the mean time to answer during the baseline period was subtracted from the time to answer for each problem during anesthesia to give the "excess time" for the subsidiary task. For each case a 5 sample moving average of excess time was plotted vs. the case elapsed time (figure 1).

4,774 addition problems were presented during 19 cases. 40% of problems were skipped or took longer than 30 seconds to answer. 65% of these occurred

during a manual task when the subject might have had high workload or might not have been able to manually enter the answer. 35% were not associated with manual tasks, suggesting a high mental workload. Periods of highest workload occurred during pre-induction preparation (i.e. line placement), induction and emergence, as well as during intraoperative events such as initiation or termination of CPB. Some cases (e.g. cystoscopy) were associated with prolonged periods of low workload, while others (e.g. aortic valve replacement) showed several periods of high workload.

Workload is probably a major factor in determining the anesthesiologist's functional level of vigilance and ability to respond to problems.³ High workload may exacerbate the effects of stressors like fatigue, and may increase the risk of human error.² This subsidiary task paradigm could be used in carefully controlled studies comparing workload between different types of cases or different anesthesia practitioners, or in evaluating the positive or negative effects of monitoring equipment on distraction of the practitioner.



References:

1. *Human Factors in Aviation*, 1988, pp. 158-159
2. *Handbook of Perception and Human Performance*, 1986, pp. 41-1 - 41-49
3. *International Anesthesiology Clinics* 27:137-147, 1989

A1028

TITLE: THROMBOGENIC RISK OF LONG-TERM RADIAL ARTERY CANNULATION: EVALUATION BY MULTIVARIANT DISCRIMINANT ANALYSIS.
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Radial artery cannulation is a monitoring technique routinely used in intensive-care patients. Arterial thrombosis represents the most frequent and severe complication of this procedure. The aim of this study was to assess the occurrence of arterial thrombosis using bedside arteriography and to determine the discriminant factors, if any, of this complication.

After institutional approval and informed consent, 129 consecutive patients were included in this prospective study. There were 94 men and 35 women with a mean age of 57 ± 11 years, cannulated with a polyethylene catheter (leader-Cath, 0.9 mm in external diameter, 8 cm in length, Vygon, Ecouen, France). All catheters were placed percutaneously, using the Seldinger technique. They were secured to the skin and covered with an occlusive sterile dressing changed every day. Catheters were continuously flushed (3 ml/h) with heparinized (5000 in) normal saline solution (500 ml). During insertion, the following variables were prospectively noted: time for insertion, use of local anesthetic, vessel transfixion, concomitant hemostasis disorder and number of puncture attempts. While the catheters were in use, the following variables were noted: length of cannulation (days), blood samples obtained, use of I.V. heparin, episodes of collapse, use of cardiovascular drugs, and infection of catheter

tip. Arterial thrombosis was diagnosed using bedside arteriography (injection of 10 ml Hexabrix through the catheter before removal). All variables were included in a stepwise multivariate discriminant function analysis.

Catheters were used for 11 ± 7 days (range 2 - 41 days). Time for catheter insertion was 7.6 ± 4 min (range: 1 - 35 min). Vessels were transfixed in 17 % of the cases and less than 3 puncture attempts were required in 77 % of the cases. During cannulation 38 ± 15 blood samples were obtained (range: 5 - 155), 87 % of the patients were given I.V. heparin, 40 % were given cardiovascular drugs, and 20 % had at least one episode of collapse. At the time of catheter removal, 7 % of the tips had grown pathogenic germs. Nineteen per cent of patients had a complete arterial thrombosis, 57 % a partial thrombosis and only 24 % had no radiological sign of thrombosis. No sign of clinical thrombosis was observed in any patient. None of the studied variables were significantly correlated with the occurrence of arterial thrombosis. The equation generated from the stepwise discriminant analysis was: $-1.59 + \{(1 \text{ or } 2 \text{ heparin}) \times 1.41\}$. { 1 = yes, 2 = no}. The equation was only of limited value since it predicted arterial thrombosis with only 75 % accuracy.

It was therefore concluded that a high occurrence of arterial thrombosis follows the use of polyethylene catheters and that none of the studied parameters allowed for an accurate assessment of this complication.