CRITICAL CARE III— TRAUMA AND SHOCK

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Title: SEDATION OF PATIENTS WITH SEVERE HEAD INJURY. A RANDOMIZED, PROSPECTIVE COMPARISON OF PROPOFOL VERSES MORPHINE AND BARBITURATES.

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Introduction - It is often necessary to administer sedative agents to patients suffering from severe head injury. An ideal sedative would have a short half life, decrease intracranial pressure, and maintain stable systemic hemodynamics. The aim of this study was to compare the safety and efficacy of continuous propofol infusions with intermittent bolus doses of morphine and pentobarbital in patients with severe head injury.

Methods - Following institutional Human Studies Committee approval, 14 patients with Glasgow Coma scores of 8 or less were randomly assigned to receive sedation therapy with either morphine and pentobarbital or propofol. Control group patients (n=7) received 0.2 -1.0 mg/kg of morphine and pentobarbital 1-10 mg/kg as required for sedation and intracranial pressure (ICP) control. Patients in the propofol group (n=7) received an initial loading dose of up to 1 mg/kg of propofol, followed by continuous propofol infusion of 0.01-0.05 mg/kg per hour adjusted to achieve an adequate level of sedation and intracranial pressure control. If ICP was not controlled with propofol alone, barbiturates were substituted until control of ICP was achieved. Sedation was continued for 7 days or until clinical improvement was noted.

All patients were intubated and mechanically hyperventilated to achieve an initial $PaCO_2$ of 25-30 mm Hg. Additionally, mannitol 0.25 g/kg was administered as needed to control ICP. Data were analyzed with t tests and one way ANOVA as needed, $p<0.05$ was considered significant.

Results - Patients in both groups were similar with respect to age, severity of associated illness, and severity of head injury. There were no significant alteration in systemic hemodynamics in either group during therapy. Table 1 demonstrates the mean highest daily ICP measured.

Table 1. Intracranial Pressure (mm Hg)

Day	Propofol	Pentobarbital
Pre sedation	17.9 ± 5.3	11 ± 6
1	16.4 ± 7.8	11 ± 4.7
2	9.4 ± 7.1	14.9 ± 7.0
3	7.9 ± 3.9	15.4 ± 6.5
4	8.6 ± 4	12.3 ± 3.8
5	9.2 ± 4.3	14.7 ± 1.8
6	15.9 ± 8.1	13.4 ± 4.7
7	13.2 ± 6.0	14.5 ± 5.5

Table 2 shows the outcome of the patients studied.

Table 2.

Outcome	Propofol	Morphine
dead	2	1
persistent vegetative state	2	3
conscious, but disabled	2	2
independent	1	1

There is no statistically significant difference between groups in outcome.

Conclusion - Propofol provided control of intracranial pressure comparable to barbiturates in these critically ill patients. Due to this initial encouraging response, we believe that a further larger scale study of the use of propofol in severely head injured patients is indicated.

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TITLE: CAPNOGRAPHY FOR MONITORING HYPERVENTILATION OF HEAD INJURY PATIENTS

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Hyperventilation is a commonly employed modality to acutely reduce intracranial pressure (ICP) following head injury. Arterial blood gas (ABG) determinations for carbon dioxide ($PaCO_2$) have traditionally been used to guide mechanical ventilation. We undertook this study to determine whether end-tidal CO_2 ($EtCO_2$)/capnography accurately reflects $PaCO_2$ and can, therefore, reduce the requirement for serial ABG's. Further, because it has been noted that increased tidal volume may influence the arterial end-tidal CO_2 gradient ($a\text{-}EtCO_2$), we questioned what effects alterations in minute ventilation and dead space would have on the accuracy of capnography.[1]

After obtaining institutional review approval, 14 mechanically hyperventilated ($PaCO_2$ < 32 mmHg) head injured patients were studied. Six had other associated non-thoracic injuries. After a stabilization period of 30 minutes with constant minute ventilation, paired $EtCO_2$ (Nellcor N-1000) and ABG's (Instrumentation Laboratory 1304) were obtained. Other parameters measured or derived include pulse rate, respiratory rate, tidal volume, mixed exhaled CO_2 ($PeCO_2$; Perkin-Elmer 1100) and dead space (Vd/Vt). Results follow:

	$EtCO_2$	$PaCO_2$	$PeCO_2$
Average	25.7	28.4	14.2
Std Dev	3.6	1.8	2.6
	$a\text{-}EtCO_2$	Vd/Vt (%)	MV (l/min)
Average	2.71 *	49.7	14.5
Std Dev	2.84 §	8.2	4.0

(* = bias; § = precision).

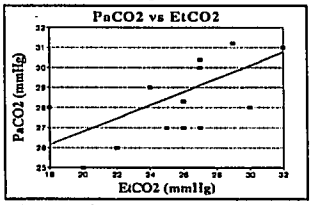

Figure 1

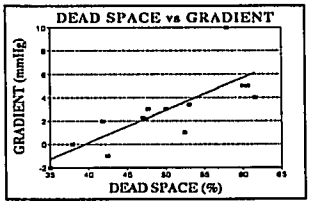

Figure 2

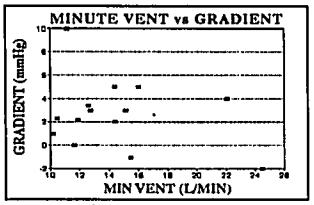

Figure 3

$EtCO_2$ and $PaCO_2$ were closely related ($r = 0.64$, $p < 0.01$, Figure 1). Dead space was the factor which most significantly affected the $a\text{-}EtCO_2$. A positive and linear relationship between Vd/Vt and $a\text{-}EtCO_2$ was observed ($r = 0.78$, $p < 0.01$, Figure 2). There was no correlation between minute ventilation and dead space or $a\text{-}EtCO_2$ (Figure 3).

We conclude: 1) Capnography accurately reflects $PaCO_2$ in hyperventilated head injured patients; 2) No correlation between minute ventilation and $a\text{-}EtCO_2$ was observed in the range tested; 3) Widening of the $a\text{-}EtCO_2$ gradient was principally caused by increased dead space and represents the most significant clinical limitation; 4) Capnography provides instantaneous information on the status of hyperventilation. When coupled with periodic dead space measurement, it can significantly reduce the need for routine serial blood gas analysis in this group of patients.

Reference

1. Br J Anaesth 56:109-119, 1984