TITLE : RESPIRATORY EFFECTS OF MEDICAL ANTI-SHOCK TROUSERS.

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Medical AntiShock Trousers (MAST) are widely used in the prehospital resuscitation of trauma patients. But recent studies have suggested that MAST does not improve survival (1). This result might be due to deleterious side-effects of MAST, including respiratory effects. The respiratory effects of MAST, which remain debatable (2), were studied in 10 healthy volunteers (32 $\pm$ 4 yrs) after ethical approval and informed consent had been obtained.

MAST were inflated with high pressures (abdominal : 60 mmHg, limbs : 80 mmHg) since it has been shown that high pressures are required to increase arterial blood pressure in hypovolemic patients (3). The following variables were measured : functional residual capacity (FRC) by standard Helium rebreathing technique, minute ventilation (VE), tidal volume (Vt), respiratory rate (RR), and abdominal contribution to ventilation (Vab/Vt) using a respiratory inductive plethysmograph, inspiratory changes in esophageal (Δ Pes), gastric (Δ Pgas) and transdiaphragmatic (Δ Pdi) pressures using two balloon catheters.

MAST inflation induced a decrease in Vt and an increase in RR which resulted in an unchanged VE, a decrease in FRC, an increase in ΔPgas and ΔPdi, and a decrease in Vab/Vt (Table). MAST induced a marked increase in end-expiratory gastric pressure (9.4 $\pm$ 3.5 vs 4.0 $\pm$ 2.0 cmH2O) and a decrease in the abdominal compartment compliance (22 $\pm$ 9 vs 100 $\pm$ 32 ml.cmH2O-1).

These results demonstrated that MAST inflated with high pressures induces significant respiratory effects which remain moderate in healthy volunteers but might be deleterious in spontaneously breathing trauma patients with shock and/or thoracic trauma.

Table : Respiratory effects of MAST (mean $\pm$ SD)

	FRC (l)	VE (l/min)	Vt (l)	RR bpm	Vab/Vt	ΔPes (cmH2O)	ΔPgas (cmH2O)	ΔPdi (cmH2O)
CONTROL	2.20	6.64	0.48	13.9	0.61	4.0	3.0	5.1
	$\pm$0.27	$\pm$2.09	$\pm$0.11	$\pm$ 2.6	$\pm$0.17	$\pm$1.5	$\pm$0.9	$\pm$3.2
MAST	1.95*	5.96	0.37	16.1*	0.26*	4.8	3.9*	8.8*
	$\pm$0.34	$\pm$1.53	$\pm$0.06	$\pm$3.0	$\pm$0.19	$\pm$2.4	$\pm$1.7	$\pm$2.4

* $P < 0.05$

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TITLE: COMPUTER ASSISTED CO_2 MONITORING USING "ARTIFICIAL NEURAL NETWORKS"

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INTRODUCTION: Capnography can be extremely useful, however continuous vigilance of CO_2 waveforms is difficult. We have created a computer based system for continuous analysis of CO_2 waveforms which utilizes traditional algorithmic methods to partition the waveform and "Neural Networks" (NN's) for waveform classification. NN's are information processing systems composed of a large number of processing elements interconnected via pathways utilizing variable connection weights. An NN can be "trained" to recognize and classify patterns. During "training" a known input is applied and the weights are iteratively adjusted until the expected output for the given input is observed. As an initial approach, we have trained two NN's to recognize capnographic evidence of spontaneous patient breathing efforts.

METHODS: With institutional approval, CO_2 waveforms during 10 surgical procedures were sampled using an IBM PC-AT interfaced to standard anesthesia monitoring equipment including infra-red spectroscopy for end tidal gas analysis. Five of the data sets were used for formulating the algorithms and training the NN's. The system was then tested on 60 15-second intervals of CO_2 waveforms from 5 data sets not used in the training of the networks.

Initially the program digitizes the CO_2 waveform at a rate of 60 samples/sec. The digitized data is used to detect and localize the end of exhalation (start of the plateau in the CO_2 waveform). Once the end of the exhalation is detected, a previously trained NN uses the prior 100 samples and determines whether the patient is being mechanically ventilated or breathing spontaneously. If mechanical ventilation is detected, the samples are used to detect the end of inspiration. A second NN will then use the sampled data and determine whether the patient has made any attempts to breathe spontaneously and, if so, will provide a warning message.

RESULTS: 165 of a total of 176 breaths were detected by the system. Those breaths not detected were spontaneous and lacked sharp edges. 21 mechanical breaths exhibited signs of patient attempts to breathe against the ventilator, as determined by careful visual examination. 18 of these 21 (85%) were properly classified by the NN. The undetected were those with only minor visual signs of breathing attempts during mechanical ventilation. Detection can be easily improved by increasing the training data.

DISCUSSION: Computer detection of irregular CO_2 waveforms can provide early warnings and information on patient status. Using NN, all irregularities in CO_2 waveforms (obstruction, restriction, disconnects, leaks, etc.) can be detected by parallel simultaneous NN, provided proper training has occurred.

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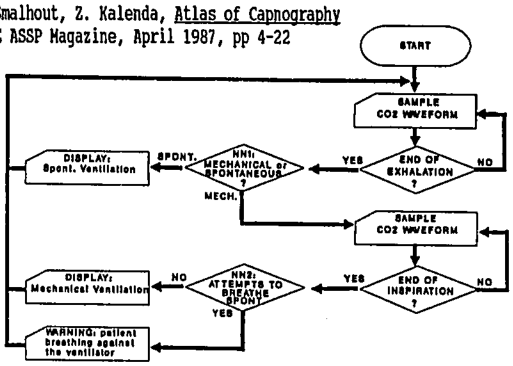

Figure 1 Breath classification algorithm.