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Title: POSTOPERATIVE INACCURACY OF LIQUID CRYSTAL THERMOMETRY

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Hypothermia, hyperthermia, and rapid temperature changes intraoperatively and in the recovery room (RR) represent a risk for the patient undergoing anesthesia. A recent temperature monitoring development (liquid-crystal adhesive strip*) has been suggested for use to follow patient temperature trends intra- and post-operatively (1). However, RR patients are often cold and therefore prone to peripheral vasoconstriction. The purpose of this study was to assess whether liquid crystal thermometry should be applied to the RR environment for monitoring of temperature.

Methods: After approval of the study protocol by the Human Subjects Committee, informed consent was obtained from patients who were to undergo surgery and subsequent RR monitoring. Excluded from the study cohort were patients (1) < 14 years old, (2) open heart operations, (3) intracranial operations, and (4) operations on the middle ear. When a patient was admitted to the RR from the operating room, the same investigator inserted a tympanic membrane probe** and placed a liquid crystal adhesive strip over the patient's forehead. Admission temperature and subsequent temperatures every 15 minutes were recorded for each patient until RR discharge. Liquid crystal temperatures were interpreted according to the reference chart supplied with the monitors. In all cases the most brightly illuminated numerials were read. The same observer read all liquid-crystal temperatures so that identical subjective interpretation applied in all cases. Results were analyzed using linear regression analysis and the Student t-test for paired data with significance defined at $p < 0.05$.

Results: The study sample consisted of 71 patients, 37 males and 34 females. Of this group, 16 patients had received regional anesthesia and 55 patients had received general anesthesia. Mean ± SE (range) were as follows: age, 49.6 ± 2.2 years (17-83); weight, 72.2 ± 2.1 kg (40-132); height, 167.7 ± 1.5 cm (121-190); body surface area (BSA), 1.80 ± 0.03 m^2 (1.22-2.45). Recovery room admission temperature measured by the liquid crystal thermometer (TS) was significantly correlated with admission temperature measured at the tympanic membrane (TM) ($r = 0.61$, $p < 0.001$) (Table). Subsequent readings after 15, 30, 45, and 60 minutes also showed a significant correlation between the two methods, although with decreasing correlation coefficients (r). Change in TS (ΔTS) over the first 15, 30, and 45 minutes of RR monitoring was not significantly correlated with change in TM (ΔTM) over the same time periods. After 60 minutes of RR monitoring, ΔTS was significantly correlated with ΔTM ($r = 0.36$, $p = 0.003$). ΔTS for the duration of recovery room stay (mean 89.2 ± 5.0 min) was significantly correlated with ΔTM ($r = 0.47$, $p < 0.001$). Recovery room admission temperatures measured 35.6 ± 0.1°C at the tympanic membrane and 32.4 ± 0.1°C by the liquid crystal thermometer (mean difference = 3.2°C, $p < 0.001$). Recovery room discharge temperatures were 36.3 ± 0.1°C for TM and 33.6 ± 0.1 for TS (mean difference = 2.7°C, $p < 0.001$).

Discussion and Conclusion. Core temperature has been shown to be more representative of a patient's physiological status than is shell temperature, and tympanic membrane temperature is the most reliable indicator of core temperature (2). In the RR environment, the liquid crystal thermometer is inadequate for following patient temperature because:

1. The liquid crystal temperature reading is poorly correlated with the tympanic membrane temperature, and

2. Changes in tympanic membrane temperature are not reflected by correlated changes in liquid crystal temperature readings over the first 15, 30, or 45 minutes of RR monitoring.

In conclusion, valid monitoring of temperature in the RR cannot be obtained from the liquid crystal adhesive strip.

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REFERENCES:

1. Burgess GE, Cooper JR, Marino RJ, et al: Continuous monitoring of skin temperature using a liquid-crystal thermometer during anesthesia. Southern Med J 71:516-518, 1978.

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CORRELATION COEFFICIENTS
Liquid Crystal Thermometers (TS) with Tympanic Membrane Probes (TM)

TS with TM*		Change (Δ) in TS with ΔTM		
RR Time (min)	r	RR Time Δ (min)	r	p
0	0.61			
15	0.54	0-15	0.04	0.361
30	0.52	0-30	0.11	0.193
45	0.42	0-45	0.25	0.064
60	0.41	0-60	0.36	0.003
Discharge	0.39	0-Discharge	0.47	<0.001

*all significant correlations ($p < .001$)