Evaluation of Gastric Tube with Esophageal Thermister (Thermosump®)

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The accuracy and the feasibility of esophageal temperature measured by a new gastric tube. Thermosump®, which is incorporated with a esophageal thermister, was evaluated in anesthetized dogs (n=6) and men (n=59). In dogs, esophageal temperature measured by Thermosump® was correlated well with the temperatures measured by the conventional esophageal thermister, and also by the pulmonary artery catheter (r=0.98, 0.98, respectively). In anesthetized men, correlation between esophageal temperature by Thermosump® and rectal, or bladder temperature was good during surgery of extremities (r=0.81, 0.80, respectively). But during abdominal surgery, correlation between esophageal and bladder temperature was relatively poor (r=0.50). Insertion of the tube, and suction of gastric fluid through the tube were easy without any complication. This newly developed gastric tube with a esophageal thermister was safe, and useful for measuring esophageal temperature. (Key words: core temperature, esophageal thermister, gastric tube)

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It is well recognized that monitoring body temperature brings an important information for the optimal patient care during surgery and in the ICU[1,2]. Rectal, or esophageal temperature is commonly measured as core temperature. Rectal temperature, however, sometimes underestimates core temperature during abdominal surgery, since abdominal cavity is exposed to the ambient temperature. Esophageal temperature is recommended in this case[3]. The new gastric tube (Thermosump®, Medicon Inc., Osaka) with a thermister probe located at 25 cm distance from the tip of the tube, has been developed to improve the convenience for monitoring and to minimize the damage of the esophageal mucosa. In this study, we evaluated the usefulness and safety of the thermister-incorporated tube in anesthetized dogs and men.

In animal study, six dogs were anesthetized with pentobarbital and pancuronium. Thermosump® and a conventional esophageal thermister were inserted simultaneously into the esophagus to measure esophageal temperature. Pulmonary artery blood temperature was measured as control value by a pulmonary artery catheter. The

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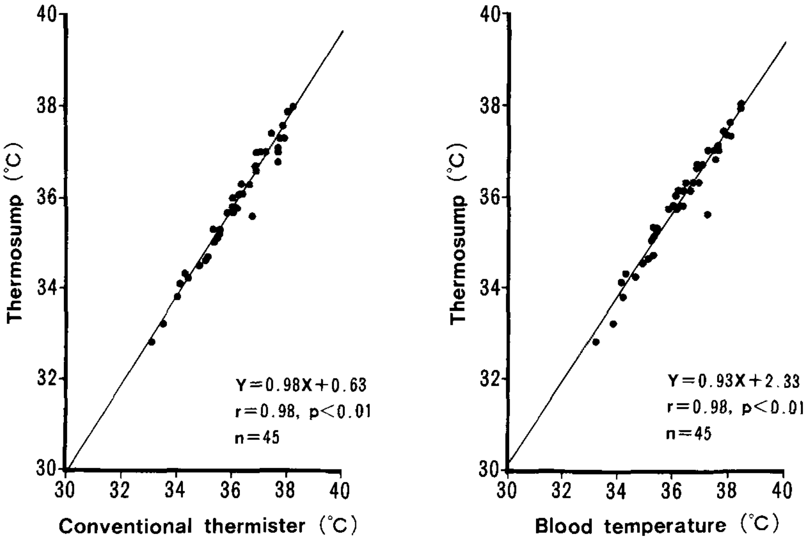

Fig. 1. Relation between body temperatures monitored in dogs.

temperatures were measured at every 15 minute for 3 hours. Gastric fluid was collected intermittently and total amount was measured. Macroscopic examination of esophageal mucosa was performed at necropsy.

Body temperatures were measured at 45 different occasions. Temperatures measured by Thermosump®, the conventionl esophageal thermister, and the pulmonary artery catheter were 35.9 ± 1.3, 36.1 ± 1.3, and 36.3 ± 1.4°C, respectively (mean ± SD). Esophageal temperature by Thermosump® was correlated well with that by the conventional esophageal thermister, and by the pulmonary artery catheter (r=0.98, 0.98) (fig. 1). However, these esophageal temperatures were significantly lower than blood temperature ($P < 0.05$). The difference was 0.4 ± 0.3, 0.1 ± 0.2°C, respectively. Suction of gastric fluid was easy, but total amount was varied among dogs. No visible damage was found on esophageal mucosa at necropsy.

In clinical study, fifty-nine ASA physical status 1 or 2 adult patients who underwent elective surgery were involved in this study after an institutional approval and an informed consent was obtained. Aftre induction of anesthesia, esophageal temperature measured by Thermosump®, rectal temperature by a conventional thermister, and bladder temperature by a Foley catheter with thermister were recorded at every 15 minute during surgical procedure. Gastric content was collected intermittently, and total amount was measured. Difficulty to insert Thermosump® catheter and complication associated with this tube was evaluated by one of staff anesthesiologists.

Body temperatures were measured at 352 different occasions during abdominal surgery, and at 422 different occasions in the surgery of extremities. Mean esophageal, rectal, and bladder temperature were 36.4 ± 0.6, 36.4 ± 0.5, and 36.1 ± 0.6°C in the abdominal surgery, and 35.9 ± 0.7, 36.2 ± 0.6, and 36.2 ± 0.6°C during surgery of extremities, respectively. During abdominal surgery, coefficient of correlation between esophageal and rectal, or bladder temperature was 0.78,

Table 1. Correlation among temperatures monitored in clinical anesthesia

	abdominal 33 cases, n=352		extremities 26 cases, n=422	
	r	slope	r	slope
Rectal temperature	0.78	1.25	0.81	1.14
Bladder temperature	0.50	2.04	0.80	1.09

($P < 0.01$)

and 0.50 (table 1). Correlation between esophageal and bladder temperature was relatively poor in these patients. The difference between the two temperatures was 0.3 ± 0.6°C, and bladder temperature was significantly lower than esophageal temperature ($P < 0.05$). During surgery of extremities, correlation between esophageal and rectal, or bladder temperature was good (r=0.81, 0.80) (table 1). Insertion of Thermosump®, and suction of gastric juice was easy. Total amount of gastric juice varied among the cases. There was no complication associated with this study.

Body temperature monitoring during general anesthesia is essential for optimal patient care, since body temperature can be easily affected by ambient temperature, transfusion of cold fluid or blood components, and extensive vasodilation by inhalation anesthetics[1,2]. Esophageal, rectal, and bladder temperature has been shown to represent core temperature, and widely monitored during clinical anesthesia.

During abdominal surgery, rectal and bladder temperature often underestimates core temperature, since abdominal cavity is open to the atmosphere[4,5]. In such cases, esophageal temperature is prefered[3]. Esophageal temperature has been shown to represent core temperature when the thermister probe is at the depth of left atrium, and the accuracy is largely dependent on its location in the esophagus[6]. Ideal location has been shown at the lower fourth of the esophagus[7]. The problem, which is encountered in clinical anesthesia, is that the insertion of the thermister is sometimes troublesome when a gastric tube is inserted simultaneously. Moreover, two foreign bodies in the esophagus may not be suitable, especially in the pediatric case.

To improve the convenience and to minimize the complication associated with insertion of the tube, Thermosump® catheter has been developed. In animal study, esophageal temperature measured by Thermosump® was correlated well with pulmonary arterial temperature, which is considered as "true core temperature"[8]. In clinical study, correlation among the temperatures measured was good, except that between esophageal and bladder temperature during abdominal surgery. Bladder temperature was significantly lower than esophageal temperature. 31 of 33 cases of abdominal surgery were gynecological cases. The bladder temperature might be mostly influenced by environmental temperature due to exposure of abdominal cavity to open air and it resulted in poor correlation between the two.

Thermosump® catheter would be more useful in pediatric cases than in adults, since the diameter of the esophagus is limited, and the insertion of both gastric tube and thermister could be traumatic in small children. However, only 14 and 16 Fr. size is available right now. We have requested the manufacturer to develop much smaller size in diameter.

In clinical anesthesia, there are two problems found in this study. One is that the position of the thermister probe is fixed at 25 cm distance from the tip of the catheter. Occasionally we must manipulate the catheter to find the appropriate position for accurate monitoring of the core temperature. The other is that the readout of the temperature was affected by the electrocautery, but it is usually found with conventional thermisters.

We conclude that this thermister-incorporated gastric tube is safe and very useful for esophageal temperature monitoring during anesthesia. Smaller size should be developed for pediastric anesthesia.

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