Title: OXYGEN CONSUMPTION AND HEAT BALANCE DURING TRANSURETHRAL PROSTATECTOMY

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Introduction. General anesthesia depresses oxygen consumption and hence heat production. During anesthesia and epidural analgesia peripheral vaso-dilation occurs and redistribution of heat from the central core to the periphery further enhances heat loss from the patients. In addition cold intravenous and irrigation fluids further decrease body temperature. The purpose of this study was to investigate the external heat loss by measuring changes in total body heat and calculate heat production from measurements of oxygen consumption in patients undergoing transurethral prostatectomies.

Methods. Twenty-five patients with no major medical condition were randomized to receive either low epidural or general anesthesia during the transurethral prostatectomy. Measurements of mean body temperature (MBT) and mean skin temperature (MST) were performed using the formula MST = 0.3 x (T-chest and T-arm) + 0.2 (T-thigh + T-calf) and MBT = 0.66 x aural temperature + 0.34 x MST. Total body heat (TBH) was calculated from the formula TBH = MBT x 0.83 x 4.18 x weight (kg). Oxygen consumption was measured by a Perkin Elmer mass spectrometer and corrections for nitrous oxide, carbon dioxide and relative humidity were made. A canope system was used with an airflow of 40 l/min when oxygen uptake was measured on spontaneously breathing patients. Temperature measurements were performed immediately before anesthesia, after 15 minutes of anesthesia and every 15th minute during the surgical procedure. Half an hour after the end of surgery two postoperative measurements were made with the last recording 60 minutes after the end of surgery. Oxygen consumption was measured continuously during the study. Intravenous and irrigation fluids held ambient temperature (22°C) and no humidifier was used during general anesthesia. There were no significant differences in age, operation time, weight of resected prostate and volume of irrigation fluid between the two groups.

Results. Aural temperature decreased by 1°C after 1 h surgery in both groups, the epidural group tending to decrease faster. Mean skin temperature increased significantly by 0.5°C in the epidural group but decreased in the general anesthesia group. Mean body temperature decreased by 1°C during the first hour in both groups in connection with surgery. Postoperatively it increased in the general anesthesia group in contrast to the epidural group, where it was unchanged. Total body heat decreased more rapidly in the epidural group compared to the general anesthesia group but later after 1 h of anesthesia both groups had lost about 240 kJ. Postoperatively total body heat increased only in the general anesthetic group. Heat production did not change in the epidural group during the study and averaged 218 kJ/h. In the general anesthesia group heat production decreased by 15% after the induction of anesthesia and averaged 180 kJ/h during surgery. Postoperatively, however, the general anesthesia group increased heat production by 43% compared to their basal value. External heat loss estimated as heat production plus decrease in total body heat, or minus increase in total body heat, was comparable in both groups in the postoperative period where it averaged 390 kJ/h. Postoperatively external heat loss was significantly lower in the general anesthesia group (163 kJ/h) compared to the epidural group in which it was 345 kJ/h. Plasma catecholamines did not change in the epidural group, while there was a postoperative increase in both epinephrine and nor-epinephrine by 50% in the general anesthesia group.

Discussion. In the present study there was no active rewarming of the patients during the study. Postoperative heat dissipation was unaffected by the anesthetic technique. However, if the patients had to increase the metabolic demand to fully compensate for the losses in total body heat, the epidural group had to increase their peroperative oxygen consumption by 65%, while the general anesthetic group needed an increase in oxygen consumption by 88%. These figures correspond to a peroperative oxygen uptake of 360 ml/min (SPOS), on an average. In all patients there was a significant positive correlation between age and decrease in mean body temperature during the first hour of surgery. In consistence with earlier reports the ability to increase oxygen consumption in the postoperative period showed a negative correlation to age, despite the older patients' greater fall in mean body temperature. The postoperative increase in nor-epinephrine in the general anesthetic group correlates to their increase in total body heat, this possibly reflecting the thermoregulatory effects of nor-epinephrine. At the end of surgery the patients in the epidural group had a core and skin temperature which normally should have triggered shivering. However, no increase in oxygen uptake or catecholamines could be detected though the lumbar epidural blockade did not exceed Th 5.

References.