# SHIVERING DURING TRANSURETHRAL RESECTION OF THE PROSTATE UNDER SPINAL ANALGESIA

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## SYNOPSIS

**A high incidence of shivering was found in Chinese patients undergoing the operation of transurethral resection of the prostate under spinal analgesia using irrigating fluid at ambient temperature when the operating time exceeded 45 minutes. Bacteraemia was not found. The cause of the shivering was heat loss, both from the use of cool irrigating fluid and from vasodilation due to spinal analgesia. Shivering was effectively prevented by simple measures aimed at cutting down on general heat loss from body surface and supplying heat to the body by conduction from a warm under-blanket. A warm sensation from the skin of the upper part of the body (not blocked by spinal analgesia) and from the respiratory mucous membrane also contributed to the lowered incidence of shivering.**

## INTRODUCTION

Hypothermia and shivering (1) are known complications of transurethral resection of the prostate (TURP) using irrigating fluid at ambient temperature. In contrast to the reported low incidence of shivering elsewhere (1, 2, 3), this complication is commonly seen during TURP under spinal analgesia in our Chinese patients. However, spinal analgesia for TURP has advantages compared with general anaesthesia, such as early detection of ruptured urinary bladder and cerebral oedema due to excessive fluid absorption.

Shivering increases metabolism and oxygen demand of the body. This may upset the delicate balance between supply and demand in patients with cardiopulmonary diseases, especially the elderly patients. Severe degree of shivering during an operation is a source of discomfort to the patient and may also interfere with the performance of precise surgical procedures.

The purpose of this study is to document the high incidence of shivering in our patients while undergoing TURP under spinal analgesia, and to find a simple practical way to overcome this problem. Patients given general anaesthesia were not included because it is known that general anaesthetic drugs cause disturbances in shivering control (4).

## MATERIALS AND METHODS

Only ASA class 2 and class 3 patients undergoing TURP for benign prostatic hypertrophy under spinal analgesia were studied with respect to body temperature changes and incidence of shivering. Theatre temperature was maintained between 21°C and 22°C. 1.5% glycine at ambient temperature (21°C-22°C) was used for irrigation of the urinary bladder. Premedication consisted of no more than 50mg pethidine given intramuscularly one hour preoperatively. Spinal analgesia was achieved with the subarachnoid injection of 3.2 to 3.8 ml of 0.3% tetracaine in 6% dextrose to produce analgesia up to T9 or T10.

Patients were divided randomly into two groups. Group I patients (control) were covered with one cotton blanket during operation. Group II patients (with warming facilities) had, in addition, one electric under-blanket, an oxygen mask connected to a heated humidifier (Fisher & Paykel Ltd., New Zealand) with the under-mask temperature set at 32°C, and a blood-warmer (water bath temperature 37°C) for warming the intravenous infusion fluid and blood transfusion; the limbs of these patients were also wrapped in cotton towels to diminish heat loss by radiation and convection. The electric under-blanket (Model L19, Electric Blanket Manufacturing, Australia) had a power output of 70 watts; it was doubly covered with sheets of mackintosh. A thermister (Model TM-210, Electromedics Inc., U.S.A.) was placed next to the skin between the scapulae to monitor the temperature continuously in case of overheating. Body temperature was measured every 15 minutes with another thermister (Model TM-210, Electromedics Inc., U.S.A.) placed sublingually. As cocling of the body is proportional to the duration of surgery (1, 2, 3, 5), patients whose operation times were less than 45 minutes were excluded from the study. All patients were observed closely for the occurrence of shivering by visual inspection. Should shivering occur, blood culture was taken to rule out the existence of bacteraemia. As large heat losses may occur during transfer to the recovery room due to the removal of the drapes for cleaning (6), this was avoided by suitable covering at this stage.

## RESULTS

Group I (control) consisted of 16 patients and Group II (with warming facilities), 24. There was no statistically significant difference between the two groups with regard to age, body weight, duration of operation, amount of blood transfusion, and volume of 1.5% glycine solution used for irrigation of the bladder (Table 1). Results were analyzed by Student's t test.

The thermister in contact with the skin between the scapulae showed a temperature varying between 38°C and 42°C. The mean body temperatures of Group I and Group II patients were shown in Figure 1. While the temperature curve of Group I patients showed a progressive fall, there was a definite tendency for the temperature curve of Group II patients to "plateau off". Statistical analysis, using Student's t test, showed a significant difference in the temperatures between the two groups at 15, 30, 45, 60, 75 and 90 minutes.

Among the 16 patients in Group I (control), 12 shivered (incidence = 75%). This was in sharp contrast to the patients in Group II (with warming facilities), in whom only 3 out of 24 shivered (incidence = 12.5%). Statistical analysis, using the Chi-square ($\chi^2$) test with the application of Yates' correction, showed a highly significant difference ($p<0.001$) between the two groups (Table 2).

All the patients who shivered were then separated from those who did not, irrespective whether they belonged to Group I or Group II. Analysis of the data, using Student's t test, did not show any statistically significant difference between the shivering and non-shivering groups with regard to age, body weight, duration of surgery, amount of blood transfusion, and volume of glycine used for irrigation of the bladder (Table 3).

All blood cultures taken were negative. It was also found that shivering was not related to any particular body temperature, the drop of temperature before shivering occurred varying between 0.3-2.5°C.

**TABLE 1**
**COMPARATIVE ANALYSES OF GROUP I (CONTROL) AND GROUP II (WITH WARMING FACILITIES) PATIENTS (MEAN ± SD)**

| | Ages of patients (years) | Body weight (kg) | Duration of operation (mins.) | Amount of blood transfusion (ml) | Volume of irrigating fluid (litres) |
|---|---|---|---|---|---|
| Group I n = 16 | 70.3 ± 8.4 | 54.1 ± 10.3 | 76.9 ± 19.0 | 244 ± 271 | 28.0 ± 8.2 |
| Group II n = 24 | 69.4 ± 7.1 | 55.8 ± 8.2 | 74.5 ± 20.9 | 273 ± 278 | 27.8 ± 10.5 |
| Statistical significance | n.s. $p>0.5$ | n.s. $p>0.5$ | n.s. $p>0.5$ | n.s. $p>0.5$ | n.s $p>0.5$ |

n.s. = not significant

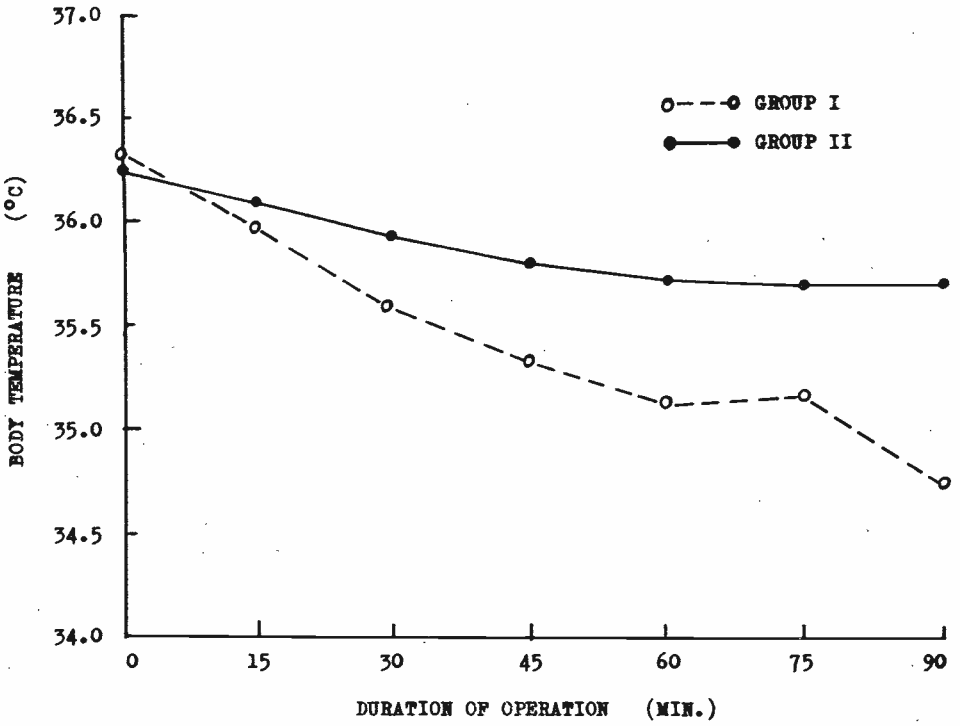


**FIGURE 1** — Fall in mean body temperature during TURP in Group I (control) and Group II (with warming facilities) patients. Temperatures between the two groups were statistically significantly different at 15, 30, 45, 60, 75 and 90 minutes.

**TABLE 2**
**STATISTICAL COMPARISON BETWEEN GROUP I (CONTROL) AND GROUP II (WITH WARMING FACILITIES) WITH RESPECT TO NUMBER OF SHIVERING PATIENTS**

| | Group I n = 16 | Group II n = 24 | Statistical significance |
|---|---|---|---|
| Number of shivering patients | 12 (75%) | 3 (12.5%) | $p < 0.001$ |

**TABLE 3**
**COMPARISON BETWEEN SHIVERING AND NON-SHIVERING GROUPS (MEAN ± SD)**

| | Ages of patients (years) | Body weight (kg) | Duration of operation (mins.) | Amount of blood transfusion (ml) | Volume of irrigating fluid (litres) |
|---|---|---|---|---|---|
| Shivering group n = 15 | 71.8 ± 7.9 | 54.3 ± 10.4 | 71.3 ± 19.0 | 240 ± 206 | 25.2 ± 6.7 |
| Non-shivering group n = 25 | 68.5 ± 7.3 | 55.7 ± 8.2 | 77.9 ± 20.4 | 274 ± 308 | 29.6 ± 10.7 |
| Statistical significance | n.s. $0.5 > p > 0.1$ | n.s. $p > 0.5$ | n.s. $0.5 > p > 0.1$ | n.s. $p > 0.5$ | n.s. $0.5 > p > 0.1$ |

n.s. = not significant

## DISCUSSION

Shivering increases oxygen demand of the body. In the elderly patients with cardiopulmonary disease with history of arrhythmias or angina, shivering may easily upset the delicate supply/demand relationship. Severe degree of shivering may also interfere with the performance of surgery (5).

Bacteraemia may occur during TURP (7, 8) and rigor may result. Blood cultures were therefore taken in those patients who started to shiver during operation, but all cultures were negative.

An obvious cause of shivering is heat loss due to the use of irrigating fluid at room temperature, combined with vasodilation over the lower part of the body while under spinal analgesia (5). One way to overcome the cooling problem is to use warm fluid for irrigation of the bladder (1, 9). Two patients, not included in the study, underwent the operation with irrigating fluid at a temperature of 32°C. Shivering did not occur but the surgeon had the impression of increased bleeding during the resection. Although increased bleeding had not been the experience of others who used warm fluid for irrigation (1), we had to find another method to overcome the shivering problem due to our experience in these two patients.

The primary motor centre for shivering, in the dorsomedial portion of the posterior hypothalamus, is normally inhibited by heat signals from the pre-optic heat thermostatic area but is stimulated by cold signals from the peripheral receptors (4, 10). In other words, skin and mucous membrane temperature changes can alter the set-point for shivering. Heat production is increased when head temperature falls below a given threshold value, but the threshold for the response is lower and its magnitude decreased when the skin and mucous membrane temperature is increased (11). Wrapping the limbs in cotton towels decreased heat loss by radiation and convection. Use of a blood warmer with a heat exchange coil cut down on heat loss due to infusion of intravenous solution and blood transfusion. Breathing warm humidified oxygen-enriched air from a heated humidifier conserved heat loss from vaporization and also prevented cooling of the respiratory mucous membrane. Most importantly the use of a warm under-blanket at a temperature of 38°C-42°C allowed heat to be actively conducted to the patient. A blanket temperature of 38°C-42°C is allowable as it has been shown that temperature of 45°C or less were incapable of inflicting even microscopically recognizable burns (12). That the above method served to cut down on the problem of heat loss was shown by the fact that the temperature curve of the Group II patients showed a tendency to plateau off, in contrast to that of the control group. As peripheral receptors have controlling influence on shivering (4), the warm sensation from cutaneous receptors of the upper part of the body (not blocked by spinal analgesia) and from the respiratory mucous membrane must have also contributed to the lowered incidence of shivering found in the present study.

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