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Anesthesia AND Analgesia

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Body Temperature Changes During Organ Transplantation

Journal of the International Anesthesia Research Society

Volume 49, No. 3

May-June, 1970

PRINTED
IN
U.S.A.

Body Temperature Changes During Organ Transplantation

J. ANTONIO ALDRETE, M.D.

HENRY W. CLAPP, M.D.

THOMAS E. STARZL, M.D., Ph.D.

Denver, Colorado*

WITH the transplantation of different organs there are specific problems of anesthesia according to the kind of physiologic derangements predating operation and the type of homograft that is being used. However, common to all these procedures are the necessities to abruptly expose the recipient to alien tissue and to provide immunosuppressive treatment for prevention of its subsequent rejection.

During the administration of anesthesia to more than 300 recipients of whole organ homografts, a number of examples of increased or decreased temperature have been observed in the intraoperative period. This communication will deal with the incidence, magnitude and evolution of these alterations and will attempt to correlate them with the

anesthetic agents, the organ transplanted, and the immunosuppressive therapy being employed.

MATERIALS AND METHODS

The anesthetic records of 275 patients undergoing transplantation procedures at the Colorado General and Veterans Administration Hospitals at Denver were analyzed retrospectively. Of these homografts, 238 were kidneys, 32 were livers, and three were spleens. One patient received a heart and a kidney at the same sitting, and one more, only a heart.

Changes in body temperature were recorded by an esophageal or rectal thermistor. A correlation was made with the main anesthetic agent. When significant temperature alterations occurred, other pre

*Departments of Anesthesiology and Surgery, University of Colorado Medical Center and Veterans Administration Hospital, Denver, Colorado 80220.

Support by United States Public Health Service Grants AM-06344, AM-07772, FR-00051, AI-04152, FR-00069, AM-12148 and AI-AM-08898.

and transoperative factors that could be responsible were investigated.

Alterations of temperature were considered when a variation from the initial reading occurred (usually taken after induction of anesthesia and endotracheal intubation). The highest or lowest readings observed were then noted. Increases or decrements were determined by the greatest deviation from the first value recorded.

RESULTS

Renal Homotransplantation—There were 238 anesthetics administered to 220 patients; 18 recipients were given second or third organs when the first homografts failed. Unfortunately, in most of the early cases the body temperature was either not monitored or not recorded. Consequently there were only a total of 76 well-studied patients (Table 1), 13 before June 1966 and 63 after this date.

TABLE 1
Patients Undergoing Renal Transplant;
Recorded Body Temperature

| Year | Number of cases with recorded temperature | Temperature changes | |
|------------------|---|---------------------|-------|
| | | Falls | Rises |
| 1963 | 1 | 1 | |
| 1964 | 1 | 3 | |
| 1965 | 7 | 7 | |
| Before June 1966 | 4 | 4 | |
| After June 1966 | 10 | 3 | 7 |
| 1967 | 18 | 4 | 14 |
| 1968 | 21 | 6 | 15 |
| 1969* | 14 | 4 | 10 |
| Totals | 76 | 32 | 46 |

* To August 31.

The division into these two time periods was made because horse antihuman-lymphocyte globulin (ALG) was introduced at our center as a clinical immunosuppressive agent in the early summer of 1966. From then onward, ALG was started intramuscularly in elective cases several days in advance of operation. Where cadaveric organs were used, the ALG was instituted by the same route of injection either during operation or after return to the recovery room.

In the 13 recipients observed before June 1966 there were regularly falls in temperature during operation which were invariably minor. After this time, hyperthermia became common. The usual pattern was an initial drop of temperature averaging 1.25° C during the first three intraoperative hours followed by an upward trend from the fourth hour on (Figure). The maximum

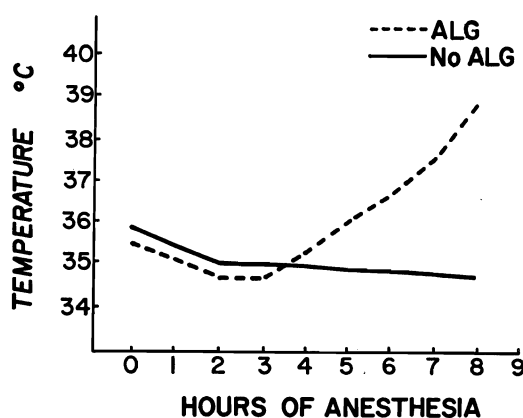


FIGURE. Usual trend of body temperature alterations in 76 patients undergoing elective renal homograft, of whom 63 were pretreated with anti-lymphocytic globulin (ALG).

★ J. ANTONIO ALDRETE, M.D. is a 1960 graduate of the National University of Mexico, College of Medicine, in his native Mexico City. A residency in anesthesiology at University Hospitals, Cleveland, Ohio, followed an internship and two years of surgical training in the United States. He served a third year in anesthesiology at the University of Colorado Medical Center, where he currently holds the rank of Associate Professor of Anesthesiology. He is the Chief Anesthesiologist of the Veterans Administration Hospital in Denver.



increases in temperature were usually small (less than 2° C) but in six cases the body temperature rose to more than 39° C (maximum 39.8° C).

Hyperthermia was not noted under two circumstances, when cadaveric organs were used and when cold blood transfusions were given exceeding a total of 1500 ml. There was no apparent correlation between the temperature changes and the anesthetic agent used (Table 2).

Liver Transplantation — Twenty-eight orthopedic and four auxiliary homografts were employed. Immunosuppressive treatment was with azathioprine and prednisone in seven cases; 22 of the patients also had ALG started just before or during operation. Falls in body temperature were seen in all recipients, more so in children than adults. This trend toward hypothermia took place in spite of the use of the conventional warming blanket and the "warming coil." Detailed examination of the records revealed that in 16 cases, an abrupt decline of temperature was evident soon after revascularization of the homograft, averaging 0.9° C and ranged from 0.7 to 1.8° C. After removal from the operating room, 17 patients developed febrile episodes ranging between 38 and 39.8° C which usually decreased gradually in the subsequent 24 hours.

Cardiac Transplants — During one case of simultaneous heart and kidney transplantation to the same recipient, the body temperature alterations were influenced by the needs dictated by the extracorporeal circulation. The temperature was lowered by the heat exchanger to 30° C during cardiopulmonary bypass and restored to normal by the same mechanism after the transplant was completed. Within two hours of the operation, the temperature rose to 39° C and then gradually subsided during the

following 24 hours. Similar temperature changes were observed during the intraoperative period in another patient that received a heart homograft.

Splenic Transplants — The records of three patients were available. Elevated temperature developed in one of these recipients who received ALG for three days before the operation. This rise went from 36° C to 39.2° C from the third to the fifth hour of surgery.

DISCUSSION

The observations in the present communication emphasize the value of careful monitoring of temperature in recipients of organ homografts, as well as the need to provide for means of intraoperative temperature control. To date, there have been few reports of the anesthetic management in this new field of surgery¹⁻⁸ and these have contained scant mention⁹ of the possible changes in the body temperature that can occur.

With the liver, the major alteration has been with acute hypothermia. The observed falls of temperature seemed partly explicable by the large volumes of blood and fluid that were administered. In addition, a contribution was probably made by the homograft itself which was usually 10° C or less at the time its blood flow was restored¹⁰; an immediate total body cooling effect was usually observed. In these patients, a rebound to a higher than normal temperature ordinarily did not occur until after the patient had been removed from the operating room.

The transplantation of the smaller organs, the kidney and spleen, were not necessarily attended by intraoperative hypothermia. Instead, the most common finding was an increase in temperature. This was not observed in the few patients treated before June 1966 and who had accurate temperature measurements taken. It was seen in the majority of recipients after this time, a difference which was probably explicable by the fact that the later patients were under treatment with ALG, an agent that very often causes fever.^{11,12,13,14} Indictment of ALG as an important etiologic factor was suggested by the fact that the cadaveric kidney recipients, who customarily could not have a pretreatment course of ALG, did not usually exhibit intraoperative temperature rises.

TABLE 2
Correlation of Temperature Changes
During Renal Homotransplantation
and Anesthetic Agents Used

| Primary anesthetic agent | Change in temperature | | Totals |
|--------------------------|-----------------------|----------|--------|
| | Increase | Decrease | |
| Halothane | 19 | 13 | 32 |
| Methoxyflurane | 6 | 3 | 9 |
| Fluoroxene | 18 | 13 | 31 |
| Nitrous oxide-relaxant | 3 | 1 | 4 |
| Totals | 46 | 32 | 76 |

In considering intraoperative fever in transplant recipients, other factors must also be weighed. Common to all such procedures is the introduction of foreign tissue which is expected to induce an immunologic reaction of variable magnitude and at an unpredictable time. In the patient who has not been presensitized to histocompatibility antigens also present in the homograft, this would be expected to develop in a delayed manner. If however, presensitization has accidentally occurred, an immediate immunologic reaction should develop. Under these circumstances prompt hyperpyrexia would not be unexpected.^{15,16}

Whatever the explanation in individual cases, the warning is clear that means must be available for the maintenance of total body temperature near normal levels during transplant operations. So far the thermal changes that have been seen have not been difficult to control. Temperature elevations appear to be slow in developing and easy to offset, in contrast to that seen in examples of malignant hyperthermia.^{17,18,19} In any case, precautionary measures and continuous body temperature monitoring may prove truly lifesaving.

SUMMARY

In a review of the transoperative records of 275 patients having organ transplants, some unexpected alterations of body temperature were observed. Prolonged surgical procedures, performed in an air-conditioned atmosphere and accompanied by the intravenous administration of cold fluids, generally resulted in hypothermia. However, when patients were pretreated with antilymphocyte globulin from 3 to 5 days before surgical operation, hyperthermia occurred in 46 of 63 kidney-transplant patients and in 1 of 3 spleen homografts, all elective procedures. Several incidents of fever were also observed in the immediate postoperative period.

In 16 recipients of liver homografts, the body temperature fell $\pm 0.9^{\circ}\text{C}$ (1.6°F) within 15 minutes of revascularization of the transplanted organ, which had been cooled for preservation. One patient developed fever immediately after having undergone a cardiorenal transplant.

This study again emphasizes the need for continuous, close followup of body temperature during anesthesia and surgical operations. In organ transplants, because of the alteration of the natural immunologic re-

sponse and the use of complicating adjuvant technics, it is recommended that the anesthesiologist be prepared either to increase or decrease the body temperature in event of severe deviations from normal.

Generic and Trade Names of Drugs

Halothane—Fluothane
Methoxyflurane—Penthrane
Fluoroxene—Fluoromar
Prednisone—Hydeltrasol
Azathioprine—Imuran

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