

ordinary precaution is necessary for the safety of the patient and operating personnel.

Copious ventilation, from 6 to 12 air changes per hour, is necessary to preclude accumulation of explosive mixtures and to reduce the concentration of anesthetics to below the physiologic threshold so that the surgeon and his personnel will not be affected.

The most important cause of accidents is probably static sparks which may result from accumulation of frictional charges on the rubber surfaces of the anesthesia apparatus, on woolen blankets, and on the bodies of the operators as they walk on insulated floors, when the humidity is quite low. Grounding the various parts of the anesthesia apparatus is not entirely effective, so long as rubber remains in use in the conventional equipment.

To prevent accumulation of static charges within the apparatus or on persons coming near to it, the measures proposed¹ are humidification of air to between 55 and 60 per cent relative humidity, grounding the

TABLE 1. APPROXIMATE LIMITS OF INFLAMMABILITY OF ETHYLENE AND ETHER²

MIXED WITH	ETHYLENE		ETHER	
	Lower Limit Per Cent	Upper Limit Per Cent	Lower Limit Per Cent	Upper Limit Per Cent
Air.....	3.0	30 ±	1.7	50 —
Oxygen.....	3.0	80 —	1.7	40 ±
Nitrous Oxide.....	—	—	3.8	26 ±

¹Limits of Inflammability of Gases and Vapors, H. F. Coward and G. W. Jones, U. S. Department of Commerce, Bulletin No. 279, 1931.

apparatus and operating table, and using conducting floors and shoes so that the operating staff and attendants will be always grounded as they move about. The significant factor is the absolute humidity, rather than the relative humidity, because upon it depends the electrical conductivity of the atmosphere. The principal objection to artificial humidification is the necessity of constant supervision to make sure that the apparatus is functioning properly.

Artificial humidification in operating rooms during cold weather may also prove beneficial in reducing evaporation from exposed tissues and from the wet skin of the patient, and by allowing a lower room temperature.

Operating Room Conditions

Little is known about optimum air conditions that are necessary to maintain a normal body temperature during the course of anesthesia and in the immediate post-operative period.

Under the influence of anesthesia a patient is at a very low ebb. All anesthetics, as a rule, produce dilation of the vessels in the skin and much sweating, particularly in the case of ether anesthesia. The loss of body heat is increased considerably, while the general metabolism may be

¹The Hazard of Explosion of Anesthetics, by Y. Henderson. Report of the Committee on Anesthesia (Journal American Medical Association, 94:1491, 1930).

depressed. The organism loses ability to regulate its own body temperature and becomes unusually sensitive to chilling and post-operative complications. In order to maintain a normal body temperature, a high air temperature is necessary, as high as 90 F or higher in the case of ether anesthesia, judging from experiments on animals³.

Such high temperatures are obviously uncomfortable for the operating personnel, and in order to alleviate the condition the room temperature is usually kept between 72 and 80 F in cold weather with the patient carefully guarded with blankets and hot water bottles during and for some time after the operation.

Post-operative Heat Stroke: It would seem that surgeons have learned to fear so much the occurrence of post-operative pneumonia and shock that even in hot summer weather patients are sometimes needlessly bundled up with detrimental consequences.

In 1916 several deaths were reported⁴ of heat stroke following surgical operations, and a number of cases suffering from a mild isolation, often recognized as post-operative reaction or shock. From these observations it was concluded that all operating room activities should cease during summer heat waves with the exception of urgent operations, when every effort should be made to keep the patient cool and comfortable.

In cases of exophthalmic goitre, one investigator⁵ warns most emphatically against the performance of operations in extremely warm weather, for under such conditions the risk in spite of all precautions (prior to the introduction of summer cooling in operating rooms) is too great. An analysis of several cases over a 10-year period shows a striking rise of post-operative deaths in June, July, and August, resulting unexpectedly from extreme post-operative reaction passing onto acute hyperthyroidism.

More recently four cases were reported⁶ of post-operative heat stroke admitted 24 hours preceding operation and sheltered from direct sun rays. All four were not ill and apparently were good risks. There occurred, however, at the time of operation and for several days preceding it, a heat wave with a moderately high temperature, a high relative humidity, and no wind. In addition to warm weather, excessive loss of body fluids is believed to have been a factor in the production of heat stroke in those four cases.

Aside from the possibility of post-operative heat stroke in warm and sultry weather, the surgeon is also concerned with the lowered recuperative power of the patients, and with his own discomfort as well as the discomfort of his team, which impairs the efficiency of the technic to the disadvantage of the patient.

In view of this experience it is customary to defer major operations as much as possible until the passing of heat waves, in hospitals not equipped with cooling facilities. But there are exceptional cases, like acute appen-

³Heat Regulation and Water Exchange. The Influence of Ether in Dogs, by H. G. Barbour and W. Bourne (American Journal Physiology, 87:399, 1924).

⁴Post-operative Heat Stroke, by A. V. Moschowitz (Surgery, Gynecology and Obstetrics, 23:443, 1916).

⁵The Effect of Heat Upon Operations for Exophthalmic Goitre, by A. J. Walton (British Medical Journal, 1:1045, 1923).

⁶Post-operative Heat Stroke, by T. M. Martin (Journal Missouri Medical Association, July, 1928. Abstract Anesthesia and Analgesia, 8:23, 1929).