

Editorial Views

Operating Room Electrical Environment and the Anesthesiologist

THE RESPONSIBILITY of the anesthesiologist with regard to operating room electrical devices is poorly defined, but it probably includes more than his interest, knowledge and ability warrant. With the proliferation of electrically operated devices used by the surgeon and the anesthesiologist, the operating room electrical environment is becoming increasingly complex. We have passed into an era in which the use of sophisticated electronic systems is almost mandatory. Electrosurgical units, monitoring equipment, endoscopes, thermal devices, tools and pumps are powered by electricity.¹ Most often these various devices are used with little thought to the electrical hazards² they introduce into the operating room. The problems associated with the electrosurgical unit are well described by Becker, Malhotra and Hedley-Whyte in this issue. It is easily seen that such problems are diverse and can be serious, and that using manufacturers' literature and instructions, common sense, and even sophisticated knowledge will not prevent them, or even necessarily help in understanding their nature.

The problems become more complex when several electrical devices are used, because they may interact in many ways. This interaction depends on the devices and is also involved with the wiring and physical layout of the specific operating room. Problems associated with the former can be anticipated in part by the manufacturer; those associated

with the latter can be determined only by a thorough examination of the operating room. The anesthesiologist's role on hospital committees assures that his interests and viewpoints are represented. Too often, those responsible for the physical aspects of the operating room have no conception of the specific manner in which the equipment within it is used. Equipment interaction is aptly demonstrated by the interference that appears on the ECG monitor whenever the electrosurgical unit is in use. There are other subtle interactions which can result in harm to the patient and/or operating room personnel. Many times persons have received shocks while touching metal surfaces during the operation of the electrosurgical unit. The usual reaction is either to replace the suspected equipment or to ignore the shock. Rarely is an attempt made to determine the source or cause of the errant current. The Becker article illustrates the kind of effort needed to locate and identify these complex hazards. It is foolish to suggest that every hospital be prepared to explore equipment function to the extent described in this paper. Still, it is necessary that a proper body of knowledge be available to all concerned. Hospital maintenance personnel and equipment users can then be apprised of problems that can occur and of the idiosyncrasies of given pieces of equipment. This body of knowledge must come from the major centers, manufacturers, and special research groups.³ Obvi-

ously, the safeguards established by the manufacturer form the basis for safe operation of equipment. Yet we see in this issue that the safeguards may give a false sense of security.

The basic responsibility for the safety of equipment in the operating room rests with the hospital. The equipment is usually hospital-owned and maintained. It is up to the hospital to provide adequate preventive maintenance programs to assure safe operation. However, hospital personnel must be aware of the existence of these problems before prevention programs can be implemented. They can refer to a very thorough study and discussion of electronic equipment in critical care areas and its problems published by the Inter-Society Commission for Heart Disease Resources.¹ When new equipment is purchased, the hospital can require the manufacturer to provide adequate manuals for the operation and maintenance of the equipment and also to train adequately in both operation and maintenance a sufficient number of personnel. Blanket safety specifications which require that all equipment meet or exceed certain published safety specifications and that this compliance be demonstrated on delivery of the equipment can be provided. This kind of approach takes much of the load off the hospital and puts it onto the vendor. Even the smallest hospital can use its purchase order as a quality control method.

Every hospital should have an electrical safety committee and should have an individual who is responsible for the investigation of safety problems. Some of the new electrical codes⁴ and safety recommendations^{5,6} need thoughtful application to each individual hospital. Enormous sums of money would be necessary to implement every new idea on electrical safety. Well-thought-out programs for gradual change can result in considerable upgrading without catastrophic effects on the hospital budget. Hospitals can hire the services of consultants to inspect their facilities and report on their electrical safety status. Once this is known, a program to deal with the problems can be established. In terms of the hospital facility, identification of the problem is difficult, since the availability of appropriate experts is limited. Except for a few

fortunate institutions, outside help will always be needed. The Joint Commission on Accreditation of Hospitals has recognized this need and is expanding the requirements for hospitals to avail themselves of such help.⁷

Part of the continuing requirement of safety is the documentation of tests, calibration data, and repairs. This information is needed for proper maintenance programs, as well as to identify problem areas of specific pieces of equipment. Calibration data should be affixed to appropriate instruments so that the operator knows what to expect from specific dial settings. Fortunately, most medical electronic equipment is viewed very simplistically, so it can be used long after its precision is gone. Medical instruments either work or they don't. Few persons recognize degradation of function. So long as a piece of equipment APPEARS to be working, that is, the lights light, it makes the right noise, and its output seems to be within biological variation, it is said to be working properly. Gradual failure of a device is not recognized because changes can be attributed to "patient variability." Since most medical measurements depend on the detection of change rather than precise measurement, inaccuracy in instruments may go undetected for long periods. The only way to detect these gradual changes is with a periodic testing program. The defibrillator is a good example. It is taken for granted, rarely used, and never tested until it is needed, and then the test is a clinical one. Many times the first indication of defibrillator failure has been the lack of success in a resuscitation attempt. That is the wrong time to find out whether it is functioning properly. Testing does not provide guarantees, but it does increase the confidence level in the proper operation of a device. Physical deterioration of equipment can lead to unsafe conditions independent of the functional performance. Accidental contact of internal circuitry with the cabinet or other parts can make a device lethal. Incidental contact with an instrument with high voltages accidentally imposed on the cabinet sometimes causes death.

The implementation of a testing program is no small task for any hospital. The hospital may subscribe to a testing service or provide

basic test instruments for its maintenance personnel. Either way, periodic testing can and must be done. Several manufacturers now produce test equipment designed specifically for the hospital. As with most equipment, there is wide variation in both function and quality, so it behooves the purchaser to examine the product carefully. The benefit of testing is twofold. First, the function and calibration of the equipment can be kept within acceptable boundaries of clinical need, and second, potential problems can be identified before the patient or user gets involved in a hazardous situation. Regardless of the care given to equipment selection and maintenance, a basic part of the safe use of electrical devices is education. All personnel must be instructed in the basic concepts of safety and what they as individuals can do to use equipment properly and to inspect for malfunctions or hazards. This includes such simple things as examining a plug before inserting it into a wall outlet or receptacle. Every hospital maintenance engineer has some horror story which resulted from ignorance of simple facts and which could have been easily prevented.

The anesthesiologist is especially suited to identify changes in equipment function in the operating room and to inform those responsible so they may take any needed corrective action. The anesthesiologist may not be able to check equipment in use personally, but as a member of the hospital staff he shares the indirect responsibility to ensure that the hos-

pital provides for such checks. Not only is it part of his responsibility to the patient to be involved in operating room electrical safety, but it serves his own interest in the avoidance of personal risk. The more complex problems will be resolved only as more and more knowledgeable investigators direct their attention to the hazards of the operating room electrical environment.

DELMAR SNIDER, M.D.
*Clinical Assistant Professor
Department of Anesthesia
Stanford University Medical
Center
Stanford, California 94305*

References

1. Electronic Equipment in Critical Care Areas, Report of Inter-Society Commission for Heart Disease Resources, Circulation: XLIII, A101-A122, January 1971; XLIV, A237-A261, October 1971
2. Bruner JMR: Hazards of electrical apparatus. *ANESTHESIOLOGY* 20:396-425, 1967
3. Health Devices (periodical), published by the Emergency Care Research Institute, Philadelphia, Pennsylvania
4. Article 517, Health Care Facilities, National Electric Code, 1971 edition
5. Hospital Electrical Safety Manual, California Hospital Association, 1971
6. National Fire Prevention Association Pamphlet 76BN, Safe Use of Electricity in Hospitals, 1971 edition
7. Standard III for Special Care Units, Accreditation Manual for Hospitals, Joint Commission on Accreditation of Hospitals, 1970

