EDITORIALS

Muscle Relaxants and Pain Perception

MUSCLE relaxants, with light planes of surgical anesthesia, have been used in clinical anesthesia for nineteen years. Before the advent of these drugs, the anesthesiologist gave the anesthetic, with only enough oxygen admixed to keep the patient alive; today he gives relaxants, oxygen, and such other therapy as needed to maintain homeostasis in the operating room, with only enough anesthetic to keep the patient from consciously recalling the pain of operation. When he must artificially respire the paralyzed individual we have lost quality and quantity of spontaneous ventilation as indications of his condition; with the onset of curarization, the ability of the patient to react visibly when hurt has also gone. To reduce bleeding at the operative site, or perhaps to control noxious reflexes, paralysis of the autonomic nervous system is accomplished by the use of a ganglioplegic drug; thereafter one can no longer depend on blood pressure as a valid indication of the patient's condition. Often under conditions of ganglionic blockade, and as the rule during hypothermia and/or cardiopulmonary bypass, the peripheral pulse (if any) as well as the blood pressure (if any) must be monitored by electronic means. There is a not entirely humorous resemblance between the patient whose respiratory and autonomic nervous systems have been paralyzed, and the heart-lung preparation of the physiology laboratory.

There have been instances in the practices of many anesthesiologists when a patient was supposed to be asleep with a certain mixture of gases, but in actuality was not asleep at all. Recent tests by Rosen[1] with varying mixtures of nitrous oxide and oxygen showed that some persons retain the ability to remember things they have heard even when their tissues are in equilibrium with 80 per cent nitrous oxide and 20 per cent oxygen. Graff[2] reported the case of a patient who was anesthetized for a vaginal hysterectomy with 67 per cent nitrous oxide and 33 per cent oxygen, intravenous thiopental, and continuous intravenous drips of lidocaine and succinylcholine.

The woman was intermittently conscious and in pain during the procedure, and could prove this by repeating conversations which she could only have heard during the operation. It is not unreasonable to suppose that the presence of memory and pain during a surgical operation might fall under the doctrine of *res ipsa loquitur* in court.

Attempts have been made to use the electroencephalogram as a monitor to show when consciousness and/or memory are present or absent. Although the presence of deep anesthesia can be deduced easily from the electroencephalogram, unfortunately, the pattern differences between light sleep and the perceiving-remembering state are small.

Walter[3] suggests, as a partial explanation of why comparatively few patients remember operative pain in spite of having been managed with paralysis and small amounts of anesthetics, that the muscle relaxants may not merely provide the surgeon with a more tractable musculature, but may also deprive the patient of a component of his conscious appreciation, namely, some of his own reflex responses to the surgical assault. This would be an example of the process of "de-afferentation." De-afferentation at work is noticed most frequently in the recovery room. In the operating room the process goes relatively unnoticed, as it is helping the anesthesiologist to keep the patient asleep. In the recovery room the patient is still partially curarized from large doses of relaxants; but, due to the painfulness of skin suturing and to the strong afferent stimulation of being moved to the stretcher, his reticular formation and the centrencephalic system are sufficiently "jangled" to enable his efferent neurons to "fire through" the residual neuromuscular block-

ade. Therefore, he ventilates well going down the hall to the recovery room. There he is placed in a soft bed, and for the first time in several hours he is left alone. His total afferent inflow declines, his reticular formation is not "jangled" so much, and as a result he becomes unable to continue "firing through" the partial neuromuscular blockade which he still has; he becomes, as we say, "re-curarized." His respiratory exchange decreases, he suffers from airway obstruction, his blood pressure rises, he becomes asphyxiated, and perhaps he expires.

The factors described in the preceding paragraph do help keep patients from remembering by making their anesthesia deeper than one might otherwise suspect it to be, but these mechanisms cannot be counted upon to protect everyone from perception and memory of operative experience under the conditions of light anesthesia and complete muscular paralysis. Thus, for reasons of humanity and charity, not to mention the medico-legal aspects of the problem, an incidence of remembrance of operation as low as 1 in 1,000 could reasonably be considered to justify a plea for a little more anesthesia and a little less relaxant. The plea is indicated, if we consider the occasional patient who *consciously* remembers discomfort and recall also the probability that *subconscious* postoperative memory of pain may persist in certain individuals! How many patients have been influenced as far as their future personalities and actions are concerned by perceived but only subconsciously remembered pain stimuli?

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Anesthesia and the Levels of Consciousness

IN this issue there appears an article describing the use of nitrous oxide for the study of various aspects of human consciousness. The authors properly point out that the use of nitrous oxide for this purpose is not new, and that in 1799 Humphrey Davy recorded the sensations produced by the agent. Upon closer inspection of the literature of the early nineteenth century, one finds that for nearly fifty years prior to the first use of nitrous oxide to relieve the pain of surgical procedure, interest was manifested in the agent primarily because of its ability to alter the level of consciousness. A careful study of Davy's observations suggest that the current report has duplicated most of them, although in a more refined manner. Thus, Davy observed on nearly every occasion in which he breathed nitrous oxide that "pleasurable, thrilling sensations" (paresthesias) occurred in his legs. He noted that hearing became more acute and light more intense. Fullness of the head, and increased motor activity were noted. He seemed particularly impressed with the vivid ideas that raced through his mind and at the completion of one of his experiments reputedly said, "What an amazing concentration of ideas!" Perhaps this flight of ideas is analogous to the euphoria described in the current experiments. Davy was aware that at the end of an experiment the ability to recall ideas that occurred while respiring nitrous oxide diminished rapidly. On one occasion he wrote, "As I recovered my former state of mind, I felt an inclination to communicate the discoveries I had made during the experiment. I endeavoured to recall the ideas, they were feeble and indistinct." On another day he wrote, "Had not remarks written immediately after the experiment recalled them to mind, I should have even doubted of their reality."