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Another Unusual Capnographic Tracing

To the Editor:—I recently observed an unusual capnographic tracing on a Sara-Plus mass spectrometer while performing a general anesthetic. This capnogram had a double plateau shape similar to that described by Gravenstein, *et al.*,[1] indicating uneven emptying of the lungs. However, the mass spectrometer also indicated the presence of nitrogen in the sample, which persisted after checking the connections for leaks and proper placement of the endotracheal tube. I began to suspect the cause of the distortion of the wave form to be air seeping through the sample line.

We use Nafion tubing and in-line water filters to remove water from the sample line. Nafion is a brand name for braided nylon tubing that is permeable to water vapor and if properly installed should allow water to escape from the sample line before it condenses. If any water does remain, an in-line water filter removes it. Unfortunately, the water filter's small pores (5–10 μm) impede the sample flow and if placed between the patient and the Nafion tubing in the sample line, may cause air to be entrained into the sample. I tested this speculation by asking our clinical engineer to measure the line pressure on both sides of the water filter. A pressure drop could be demonstrated across the water filter, and when the filter was removed from the sample line, the wave form returned to its usual single plateau shape, and nitrogen was no longer detected.

The proper installation sequence for removal of water vapor with Nafion tubing is as follows: PATIENT CIRCUIT—NAFION TUBING—WATER FILTER—EXTENSION TUBING—MONITOR. I had reversed the position of the extension tubing and the Nafion tubing in the above example. This allowed air to seep through the Nafion tubing, causing the distorted wave form and nitrogen contamination of the sample. Nafion tubing must be placed as close to the patient as possible to remove water effectively, because once the water condenses, it cannot escape from the Nafion tubing. Placement of Nafion tubing away from the patient circuit as described negates its utility and can lead to sampling errors and inappropriate patient care.

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Pioneering Curare in Anesthesia

To the Editor:—In the recent letter[1] from Knill dealing with a historic perspective on the introduction of curare in anesthesia, the author correctly states that in the early 1940s curare was used extensively by psychiatrists during electrotherapy in order to minimize bone fractures.[2] The author is mistaken, however, in stating that curare was introduced into general anesthesia *after* psychiatrists had long abandoned their experiences. In 1912, Arthur Läwen (1873–1958), a surgeon in Leipzig, reported the first successful administration of curare in combined anesthesia.[3] Curare, given towards the end of abdominal surgery, ensured adequate relaxation of abdominal muscles for better approximation and closure of the abdomen. Läwen's primary aim was to combine inhalation anesthesia and paravertebral blockade (a technique that he described in detail in 1911) with concomitant administration of curare, so as to minimize the overall amount of anesthetic drugs and thereby reduce the related risks of narcotic intoxication. Based on experimental findings using animals, he suggested the use of curare in humans as follows: "Through the administration of a suitable dosage of curarin in mice and guinea pigs, one could achieve a certain level of intoxication whereby the extremities and the principal muscles become paralyzed leaving only the diaphragm to function. First, as is known from laboratory experiments, the respiratory muscles may also be paralyzed along with the others but the animals still are kept alive through artificial respiration. Curarin intoxication is 'poisoning' which can be controlled and reversed with unusual perfection. By keeping the animals alive through artificial respiration, one can wait patiently until all curarin has been excreted and normal function returned."[3]

Läwen went further to report that a similar concept was put into practice many years ago by his colleague, Karg, in the management of patients with traumatic tetanus.[4] Karg actually performed tracheotomy prophylactically, administered curare to the patient with tetanus until respiratory failure set in, and then proceeded to institute artificial respiration.[5]

Decades later, Griffith and Johnson reported on the successful use of curare in ANESTHESIOLOGY.[6] Apparently they were not aware of Läwen's publications. Unlike Läwen, both based their experiences on those of the psychiatric patients. Moreover, both were fortunate that at that time purified curare became available and in greater quantities—a fact that may have prevented broader use decades earlier, even in anesthesiology.

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