ANESTHESIA ORAL EXAMINATIONS: A COMPUTER-BASED SIMULATION

S. E. Abram and S. Trent, Milwaukee, WI

We have developed a series of computer-based clinical anesthesia teaching programs for residents and practicing physicians in anesthesia. The purpose of the programs is three-fold: (1) to train anesthesia residents; (2) to help them prepare for oral boards; and (3) to provide clinical review material for practicing anesthesiologists.

The programs were designed to simulate the Anesthesia Board oral examinations. Each program begins with a stem question in the form of a brief case history, followed by a series of questions regarding preoperative evaluation and preparation and intraoperative and postoperative management. Unlike the open-ended questions of an oral exam, multiple possible responses are offered. However, as in oral examinations, subsequent questions are selected on the basis of previous responses. Several questioning techniques used in oral examination systems have been incorporated in the programs: (1) Correct responses to questions regarding factual information lead to further, often more difficult, questions on the same topic; (2) Multiple management techniques are offered, such as regional versus general anesthesia and inhalation versus intravenous agents; (3) Incorrect management of clinical situations leads to patient complications; correct management of complications results in patient improvement and a return to the main flow of questioning, while incorrect management causes morbidity and, if mismanagement continues, patient demise; (4) Critical events occur in each program, even if prior management is correct. There are many such events, including intravascular local anesthetic injection, coagulopathy, increased intracranial pressure, and respiratory problems.

Two counting programs run through each examination program. One scores each question; correct answers are given +1, incorrect answers 0 or, if they are particularly bad choices, -1. If two correct answers occur, one of which is a better choice, the better choice is awarded +2, the other +1. The other counting program adds the total number of graded questions answered. At the end of the exam, the total score is divided by the number of questions answered (which varies according to the pathway taken through the program) and is expressed as a percentage score.

The exam can be repeated with a listing of the correct answers given with each question. A list of references is provided, either on cathode ray tube or a printer.

The first program was written in Microsoft BASIC for the Apple II, II+, and IIe. BASIC proved rather cumbersome for such lengthy programs, and the second exam was written in Pascal. Subsequently a user-friendly, menu-driven, Pascal-based program was developed to create new programs from question flow sheets. The third exam was created using this program.
Automated Interpretation of Sensory Evoked Potentials
J. R. Boston, Pittsburgh, PA

Sensory evoked potentials (SEPs) provide a means to evaluate central nervous system function in anesthetized or comatose patients, and they are increasingly utilized for monitoring applications in the operating room (OR) and the intensive care unit (ICU). The responses are temporal waveforms with one or more peaks; the latencies and amplitudes of these peaks are usually the parameters of interest for characterizing the responses. Interpretation of the responses involves a determination of which peaks correspond to those observed in normal subjects (with possibly abnormal latencies or amplitudes), which peaks are due to noise (that commonly exists despite extensive signal averaging) in the response, and which peaks or responses are so abnormal that a correspondence with a normal response does not exist.

A major problem in continuous monitoring of evoked potentials is the need for continuous interpretation of the results. The interpretation process requires an experienced analyst. However, having an appropriate individual available for continuous monitoring for short periods (as in OR monitoring) is difficult, and for long periods (as in ICU monitoring), it is impossible. The development of automated techniques to screen or interpret the responses would greatly facilitate monitoring applications. This presentation describes several techniques that have been proposed and examines their limitations.

The steps in response interpretation include: determination of whether a response is present; identification of peaks that correspond to normal responses; and measurement of latencies and amplitudes. Several previous studies have addressed specific steps using analytical programming techniques. Response detection methods have included comparison of response amplitude to the residual noise in the response and the cross-correlation between separate responses (Wong PKH, and Bickford RG: Electroencephalogr Clin Neurophysiol 1980;50:25; Boston JR, et al: Proc IEEE Frontiers of Engineering and Computing in Health Care, 1983). Peak detection has generally involved smoothing and calculation of the first derivative (Fridman J, et al: Electroencephalogr Clin Neurophysiol 1982;53:405; Boston JR: J Clin Eng 1983;8:79), while identification has incorporated time windows (Gabriel S, et al: Electroencephalogr Clin Neurophysiol 1980;49:421). Parameter measurement is straightforward when the peaks have been identified.

These techniques have generally been correct for 80 to 90% of responses, but it is the incorrectly analyzed responses that are often of the greatest clinical interest. Although the analytical techniques can probably be improved, examination of the failures suggests that heuristic rules will need to be utilized before clinically useful automated interpretation can be achieved. These rules should incorporate the often subjective criteria used by human interpreters that are specific to particular response patterns. Examples for auditory brainstem SEPs include the relative amplitudes of peaks I, III, and V and the peak-to-following trough configuration of peak V. Production programming techniques provide a method to combine these criteria with analytical techniques.

Because of their qualitative nature, the pattern-based rules are difficult to describe. It is essential for a clinically useful system to either correctly interpret the patterns or recognize when a pattern is not within its range of knowledge. This will be a significant problem for the development of such systems.

Intravenous Nutrition: A Role for the Microcomputer in the Intensive Care Unit
D. E. R. Burt, M. Walker, and C. Austin, Bow, London, United Kingdom

The patient in the intensive care unit (ICU) often presents, as a result of injury or surgery, one of the more difficult problems in parenteral nutrition. In addition to ensuring appropriate provision for metabolic requirements, account must be taken of excessive losses of fluid and electrolytes from such diverse sources as intestinal fistulae, surgical drains, sweating, and the respiratory tract. These losses are not constant but tend to fluctuate, increasing the difficulty of maintaining effective fluid and electrolyte balance. Collating of all the sources of fluid and electrolyte loss so that they may be taken into account when compiling a feeding regimen is a tedious and time-consuming task which is often performed ineffectively. It is, however, a task for which a microcomputer is well suited.

A suite of programs has been written for the Apple II microcomputer to assist in the intravenous feeding and fluid balance management of patients in the ICU. There are five main components of the program:

1. Details on each patient being fed and the various feeding solutions available are stored on file.
2. The program is run for each patient once a day. Different sources of fluid and electrolyte loss are identified on a patient profile table, and the 24-hour volumes of these sources (and their electrolyte contents, if analyzed) are entered from the keyboard. Imperceptible losses are estimated from the patient’s temperature, degree of sweating, and the use of ventilatory assistance. Details of the previous 24-hour total volume and electrolyte outputs are displayed, as well as estimated nitrogen and energy requirements. These outputs may be accepted as they stand to form the target feeding requirements, or altered in the light of available biochemical investigations or clinical management policy.
3. Based on the target feeding requirements, and using the available algorithm, the computer will create and display the feeding regimen that most closely matches the target. A comparison table showing the target requirements and those that would be achieved by the proposed feeding regimen is displayed to enable the regimen to be checked for discrepancies. A printout of both the regimen and the comparison table may be obtained.
4. A teaching feature is incorporated that allows the user to create his or her own feeding regimen and, by means of the comparison table, examine any discrepancies that it produces.
5. The patient’s fluid and electrolyte balance over the entire feeding period may be examined graphically or in tabular form.

It is anticipated that this program will assist the ICU clinician by removing large amounts of tedious calculation and allowing clear and concise displays of fluid and electrolyte balance.