STABILOMETRY: A NEW TOOL FOR THE MEASUREMENT OF RECOVERY FOLLOWING GENERAL ANAESTHESIA FOR OUT-PATIENTS

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THE NEED TO ACCURATELY MEASURE and record recovery from general anaesthesia has become more apparent during the past few years,[1] particularly due to the increase in out-patient surgery, where it is essential to evaluate patients objectively prior to discharge.

Recovery from general anaesthesia, though it is a continuous process, may be conveniently divided into three stages.

Stage 1 (immediate recovery). This consists of a return of consciousness, recovery of vital protective reflexes guarding the airway, and resumption of motor activity. This stage usually lasts only a short time and can be accurately followed by the use of a postanaesthesia scoring system.[2]

Stage 2 (intermediate recovery). During this time the patient regains much of his power of co-ordination and subjective feelings of dizziness disappear. This stage is longer than the first stage but, following a short anaesthetic, is usually completed within one hour. At this time the out-patient may be considered fit for discharge home in the company of a responsible escort.

Stage 3 (long-term recovery). This stage may last hours or even days, during which time the residual effects of anaesthesia can only be demonstrated by precise tests of co-ordination or higher intellectual function.

We have investigated the use of stabilometry to evaluate the post-anaesthesia state following the first stage of recovery, to define more accurately when a patient is fit for discharge from the out-patient unit, that is, to determine the end of stage 2.

METHODS AND EQUIPMENT

Stabilometry (sometimes called stabilography or statokinesiography) is a method of recording

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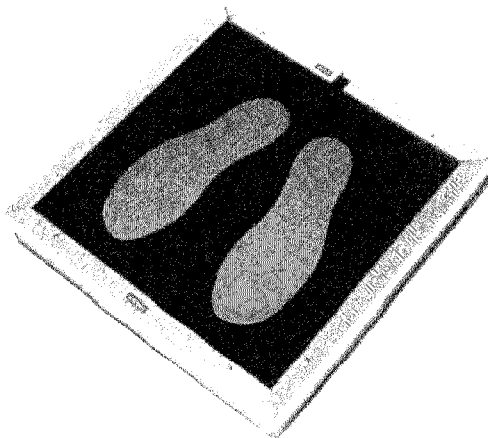
FIGURE 1. The stabilometer platform: external appearance. Note that the upper surface is marked with an outline for the feet to ensure correct positioning on the platform.

the postural adjustments made by a patient to maintain his upright stance.[3]

We have constructed a stabilometer which consists of a platform supported by a central pivot and a circular pneumatic rubber tube (Figure 2). Movements of the platform are converted to electrical signals by means of two pairs of capacitive transducers, mounted in the anteroposterior and lateral planes. These signals are recorded on a two-channel strip chart. When a subject to be tested stands on the platform a record is obtained showing the frequency and amplitude of movements of the postural muscles. These records may then be examined directly or, alternatively, the output of the transducers may also be processed electronically to provide a direct read-out of the continuous mean of the amplitude of movements. This mean of the amplitude of deflections can be made more meaningful if adjusted for the weight of the patient. Thus we have added to the circuit a compensation for body weight which can be pre-set, and which enables us to measure a "weight-compensated stabilometer score".

This machine was used to measure the changes seen during recovery from anaesthesia in a series
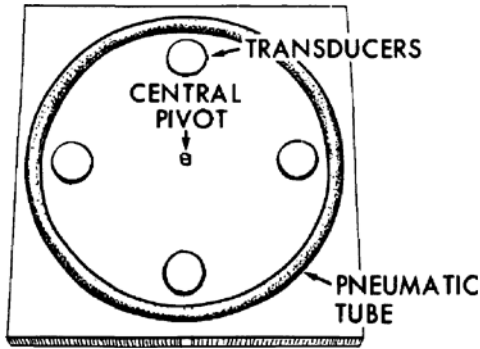
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FIGURE 2. The stabilometer platform: internal design.

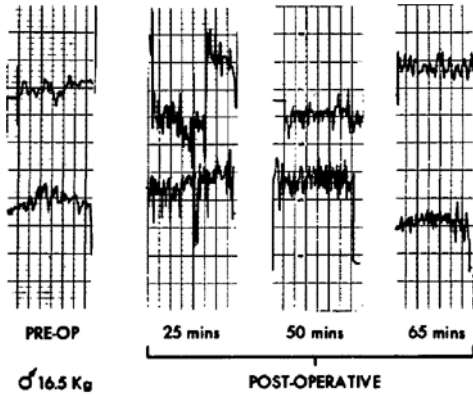PRE-OP · 16.5 Kg · POST-OPERATIVE · 25 mins · 50 mins · 65 mins

FIGURE 3. Sections of strip chart tracings from the stabilometer. The upper tracing represents antero-posterior movements, the lower tracing side to side. Post-operative tracings are timed from the end of a 20-minute halothane anaesthetic.

of healthy paediatric out-patients who had minor otological surgery. Pre-operative recordings were also made for comparison.

RESULTS

Strip-chart tracings from the stabilometer (Figure 3) show that the amplitude of the deflections is greatly increased during the early stages of recovery from anaesthesia, progressively returning to normal by 75 minutes after anaesthesia. Little change is seen in the frequency of deflections. Detailed measurement of the tracings confirms these findings (Figure 4) showing little change in frequency of movements but a marked increase in amplitude during early recov-
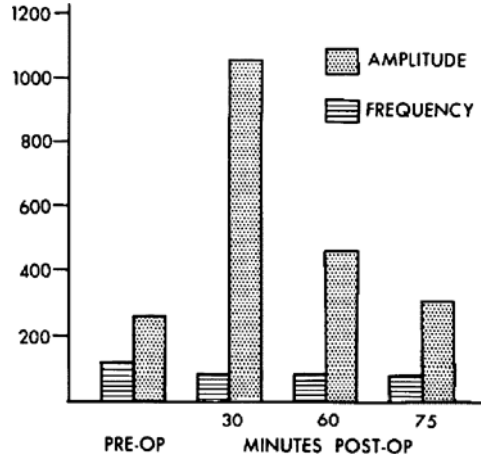

FIGURE 4. Detailed analysis of the changes in frequency (in cycles per minute) and amplitude (in millimeters of deflection) of stabilometer tracings obtained during recovery from anaesthesia.

ery which appears to fall exponentially back to pre-operative levels.

If the signals from the transducers are processed electronically and weight compensated stabilometer scores derived the results appear as in Figure 5. Preoperative scores are very uniform in healthy patients. During early recovery there is a general increase in the score and considerable scatter of results, but after one hour they are again quite uniform at near pre-operative levels.

DISCUSSION

Out-patient surgery under general anaesthesia has now become commonplace, but determination of a patient's fitness for discharge remains a problem. Immediate recovery can be objectively assessed using a post-anaesthesia scoring system, but once a full score has been attained, this is of no further help in defining the time at which a patient is fit to leave and go home. Many tests which have been described to measure recovery from anaesthesia require the use of sophisticated equipment or expert interpretation, for example, the "SIM-L-CAR"[4] or the electroencephalogram.[5] For the out-patient unit a relatively simple test is required which can be easily and uniformly applied and interpreted, and which provides a numeric recordable result.

The Rhomberg test has been used to evaluate recovery to street fitness: stabilometry is an extension of this test which offers standardization of the procedure and a numerical result.
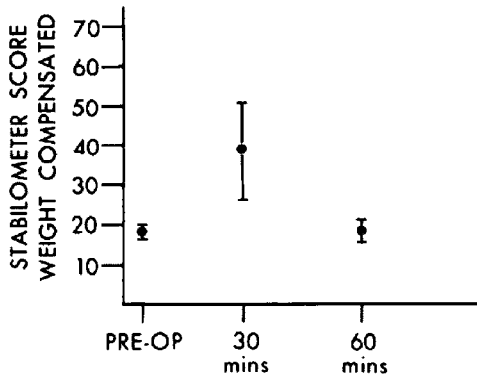
FIGURE 5. Weight compensated stabilometer scores from a series of 20 patients aged four years to 12 years following short anaesthetics (20 minutes ± 5 minutes) using halothane.

The upright posture is dependent on a chain of physiological events. Afferent impulses originating from propioceptors, pressor receptors, the vestibular apparatus and the eyes are processed within the central nervous system and so used to activate contractions of the postural muscles to maintain the dynamic equilibrium of the normal stance. In the healthy person the resulting movements are so finely controlled as to be barely detectable. Anaesthetics depress transmission in multisynaptic pathways, so lengthening the reflex time, which is recorded on the stabilogram as an increase in amplitude of postural movements. As recovery proceeds the reflex time becomes shorter and this is reflected by a progressive decrease in amplitude toward the normal.

Thus the stabilogram may be a useful clinical tool to measure the degree of recovery following general anaesthesia, and may also permit comparison of the delayed effects of different anaesthetic agents.

SUMMARY

A stabilometer has been used to measure changes in the activity of postural muscles during the later stages of recovery from anaesthesia. It is concluded that stabilometry might be a useful tool with which to measure and record the extent of recovery and that this might be especially useful for use after out-patient surgery.

RÉSUMÉ

Des capteurs à pression placés sous une plateforme supportée en son centre par un pivot et en sa périphérie par un coussin circulaire ("stabilomètre") permettent d'obtenir une mesure objective de l'activité réflexe impliquée dans le maintien de la position debout. La récupération de l'anesthésie peut ainsi être quantifiés plus précisément.

Cette mesure de la stabilité posturale nous apparaît très utile dans l'évaluation de l'état d'éveil du malade opéré, ce qui est particulièrement important pour les cas de chirurgie ambulatoire.

ACKNOWLEDGEMENT

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