A Postanesthetic Recovery Score

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EIGHTEEN years ago, at the 27th Congress of this International Anesthesia Research Society, Dr. Virginia Apgar[1] first proposed her new method of evaluation of neonates. Since then, this method has been universally adopted, and although revisions of the original scheme have been thought necessary, it remains the simplest and perhaps most reliable manner to objectively describe the physical condition of the infant at birth.[2] Recently, Downes[3] also described a similar evaluative method for newborn infants in respiratory distress.

The usual anesthetic record provides only a few spaces in which to describe the physical status of the patient recovering from anesthesia, and those are usually inadequate. In analogy to the Apgar method, we devised a score to provide objective information on the physical condition of patients arriving in the recovery room after anesthesia.[4] This is a preliminary report of an evaluation of this method of assessment.

At least one other score has been proposed for this purpose;[5] however, its complexity prevented it from being commonly accepted. Therefore, it was early recognized that, to be practical, a method of evaluation of postanesthetic patients had to be simple, easy to memorize, and applicable to all situations, whether a patient had received general, regional, or intravenous anesthesia. Moreover, to avoid added burden to recovery room personnel, only physical signs that are commonly observed were considered. A rating of 0, 1, or 2 was given to each sign, depending on its absence or presence. At the end of each evaluation, the numbers given to each sign were added. A score of 10 indicated a patient in the best possible condition.

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The times for judging the status of patients were immediately after arriving in the recovery room and every hour thereafter, until their discharge to the ward or the Intensive Care Unit.

This initial report evaluated the following signs:

1. ACTIVITY: Muscle activity was assessed by observing the ability of the patient to move his extremities either spontaneously or on command. If he was able to move all four limbs, a score of 2 was given. When only two were moved, this index was graded as 1, and if none of the extremities was moved, the score was 0. This permitted the evaluation of patients with subarachnoid or epidural blocks, and their total score was advanced when muscle activity of the lower limbs was regained.

2. RESPIRATION: Respiratory efficiency was evaluated in a form that would permit as accurate and objective assessment as possible, without the need of complicated gadgetry or sophisticated physical tests. When patients were able to breathe deeply and cough, a score of 2 was given. If the respiratory effort was limited (that is, splinting), or if dyspnea was apparent, only 1 point was awarded. If no spontaneous respiratory activity was evident, the patient received a score of 0.

3. CIRCULATION: This index was probably the most difficult to evaluate by a simple sign. We elected to use changes of arterial blood pressure from the preanesthetic level. As gross as it may be, blood pressure is still considered a reliable clinical tool for evaluating circulation. Furthermore, it is monitored throughout the anesthetic state and is one of the first physical signs taken at arrival in the recovery room in practically every hospital. The grading system was arbitrarily chosen and will probably be subject to revision as further experience is gained. When the systolic arterial blood pressure was between plus or minus 20 percent of the preanesthetic level (as obtained by the Riva-Rocci method), the patient received a score of 2. However, if the same index was between $\pm$ 20 to 50 percent of the same control level, a grade of 1 was given. When this alteration was $\pm$ 50 percent or more of the original reading, the score was 0.

4. CONSCIOUSNESS: Full alertness, as evidence for the ability to answer questions, was considered as a completely awake state and graded as 2. If patients were aroused only when called by their names, they received 1 point, or 0 if auditory stimulation failed to elicit a response. Painful stimulation was discarded, as even decerebrated patients might react to it, also because it is not a desirable maneuver to repeat frequently, and finally because development of a consistent and reliable method would be difficult.

5. COLOR: In contrast to evaluation of the newborn, this was an objective sign relatively easy to judge. When the patients appeared to have an obviously normal or "pink" skin color, a score of 2 was given. In those cases in which normal pigmentation of the skin prevented an accurate evaluation, the color of the oral mucosa was observed. When frank cyanosis was present,

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0 was awarded. It should be noted, however, that this latter discoloration would be difficult to assess in the anemic, desaturated patient. Any alteration from the normal "pink" appearance not obviously cyanosis received 1 point; this included pale, "dusky," or "blotchy" discoloration, as well as jaundice. Although some patients might have had these color alterations preoperatively, their presence in the postoperative period suggests an abnormal state that might require closer attention.

MATERIALS AND METHODS

To study this method, 352 patients were selected at random. To include as many variants of anesthesia as possible, 100 cases were taken from the Denver Veterans Administration Hospital and 152 patients from Colorado General Hospital. In both institutions, patients were anesthetized by either in-training personnel (anesthesiology residents, interns, and medical students) or by staff anesthesiologists and nurse anesthetists. Two more groups of 50 patients each were managed by anesthesiologists in communities located in the Rocky Mountain area.

These patients received all forms of anesthesia and had a variety of operative or diagnostic procedures. They were transported to the recovery room within 10 minutes of the completion of the anesthetic period; once there, the first score was made jointly by the anesthesiologist and the attending nurse. Thereafter, the evaluation was made by the same nurse, according to the criteria previously mentioned. The various signs were evaluated and a total entered on forms designed for this purpose, the Post-Anesthetic Recovery Score data sheet (fig. 1). Depending on the length of stay in the recovery room, this evaluation was repeated 1, 2, and 3 hours after the patient's arrival.

The data for each patient were then transferred to an IBM data card by keypunch process, according to a previously planned programming system; each of the 80 columns on these cards representing one of the parameters studied. These were then grouped to fit into one of the nine categories available under each column; for example, different locations of the surgical procedures were grouped topographically into specific groups (that is, head and neck).

The independent variables such as age, sex, physical status, anesthetic agents or technics, use of muscle relaxants, duration of anesthesia, were correlated with the proportional number of patients receiving top or safe scores 10, 8, or 9, and those given 7

POST-ANESTHETIC RECOVERY SCORE

Study # _____

Name _____ Age ____ Sex ____ Hospital Number _____

Date _____ Preanesthetic Risk _____ Arrival Time to RR _____

Type of Surgery _____

Anesthetic Agents _____

Muscle relaxants other than for intubation _____

Anesthesia time _____ Anesthesiologist _____

		At Arrival	1 Hour	2 Hours	3 Hours
Able to move 4 extremities voluntarily or on command = 2 " " " 2 " " " " " = 1 " " " 0 " " " " " = 0	ACTIVITY				
Able to deep breathe & cough freely = 2 Dyspnea or limited breathing = 1 Apneic = 0	RESPIRATION				
BP ± 20% of Preanesthetic level = 2 BP ± 20-50% of Preanesthetic level = 1 BP ± 50% of Preanesthetic level = 0	CIRCULATION				
Fully awake = 2 Arousable on calling = 1 Not responding = 0	CONSCIOUSNESS				
Pink = 2 Pale, dusky, blotchy, jaundiced, other = 1 Cyanotic = 0	COLOR				
	TOTALS				

FIG. 1. Postanesthetic Recovery Score Data Sheet.

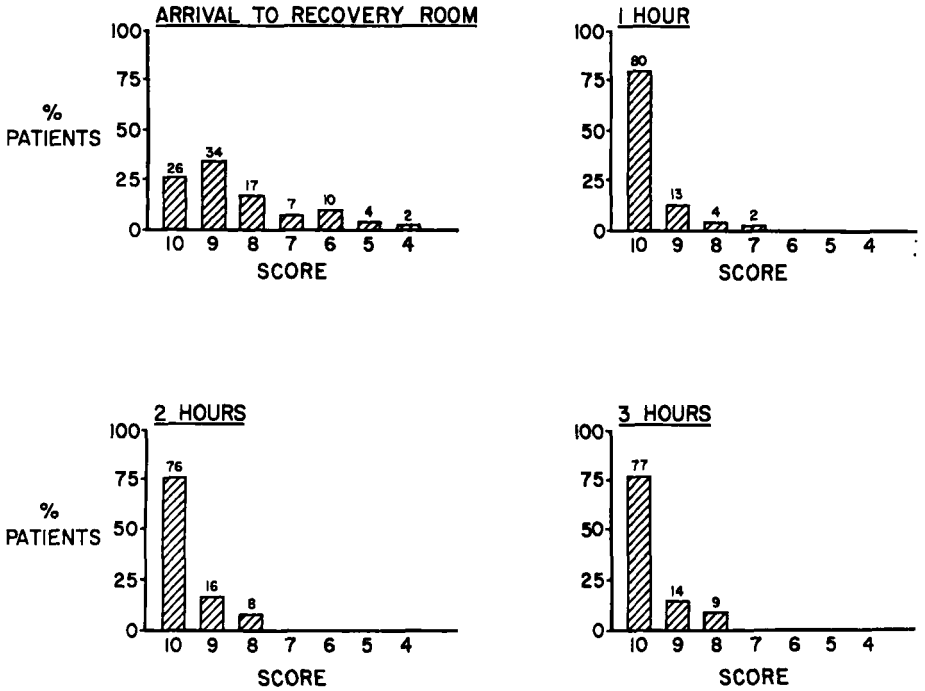

FIG. 2. Percentages of patients awarded the different total scores at arrival in the Recovery Room and their progress during the subsequent 3 hours.

or less which were considered low or dangerous.

RESULTS

Of 352 patients, 276 (78.4 percent) received scores of 8 or higher on arrival at the recovery room; there were no scores below 4. Sixty minutes later, at the time of the second evaluation, 275 (96.5 percent) of 283 patients evaluated were in the upper scores. Naturally, the number of patients evaluated decreased as more of them were discharged. Therefore, by the 2nd and 3rd hours, all patients still in the recovery room had scores of 8 or higher (fig. 2).

The anesthetic agents and technics were correlated with the percentage of patients receiving the different scores. The progression of the scores is shown from the time of arrival in the recovery room to the 3rd hour of observation (fig. 3).

Similar correlation was made of the percentage of patients receiving scores of 10, 8-9, and 7 or less, with the preoperative physical status, sex, and age (figs. 4, 5, and 6). For these and the following parameters, only the relationship at 0 and 60 minutes from arrival to the recovery room are shown, since thereafter all patients had scores of 8, 9, or 10.

At recovery room entrance, the groups of patients receiving muscle relaxants (other than for intubation) had a higher percentage of scores of 7 or lower than the group not given relaxants. However, 1 hour later, the difference was nil. In the first evaluation, the groups receiving d-tubocurarine or gallamine had fewer patients scoring 10 than in either of the other two groups. When the second evaluation was made, the patients given succinylcholine or gallamine had a higher percentage of such scores (fig. 7).

When the type of surgery was considered, patients undergoing cardiac surgery had lower total scores on arrival at the recovery room than the others. Thoracic, upper abdominal, and orthopedic operations, resulted in lower percentages of top scores (fig. 8). One hour later, these differences were less apparent.

The scores observed in the patients undergoing surgical procedures lasting from 0 to 4 hours were relatively similar, but little consistency was noted in the groups of patients submitted to operations of longer duration (fig. 9), except for absence of scores of 10 in the patients who underwent anesthesia for 8 and 9 hours.

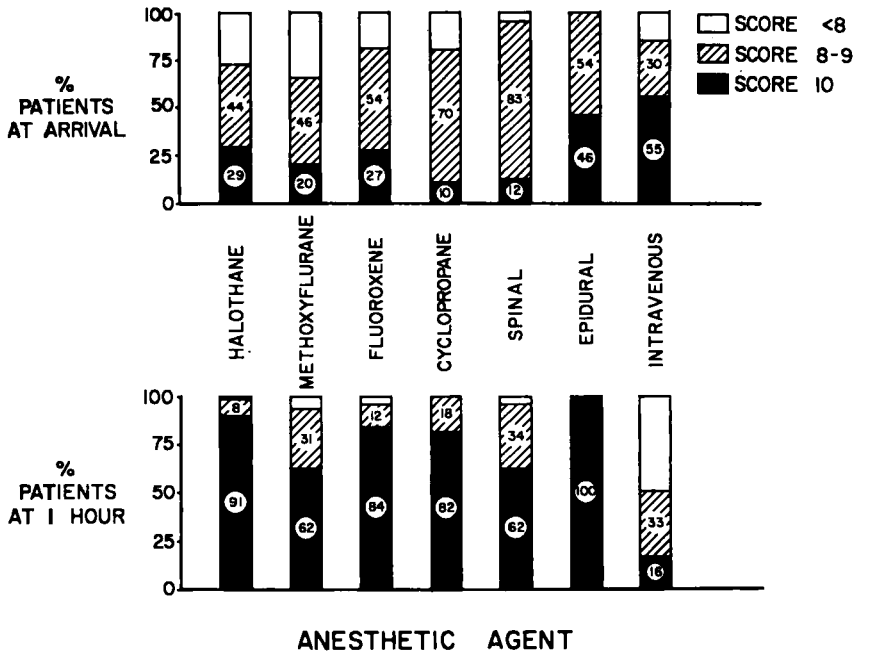

FIG. 3. Correlation of scores given to patients at arrival in Recovery Room and one hour thereafter, during their recuperation from different anesthetic agents and technics.

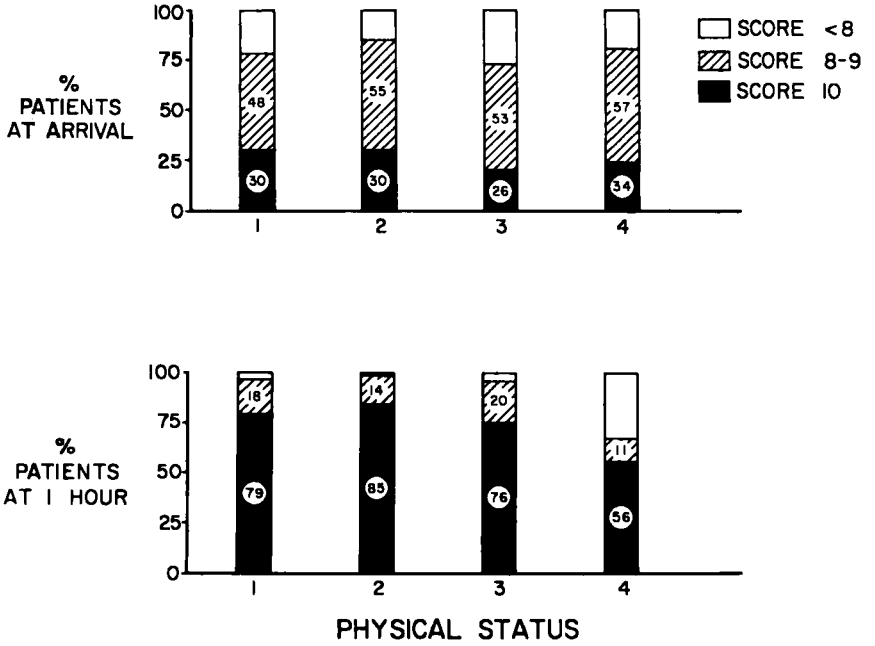

FIG. 4. With exception of a greater number of low scores in patients with physical status class IV at one hour, there was little difference in the other groups of patients evaluated.

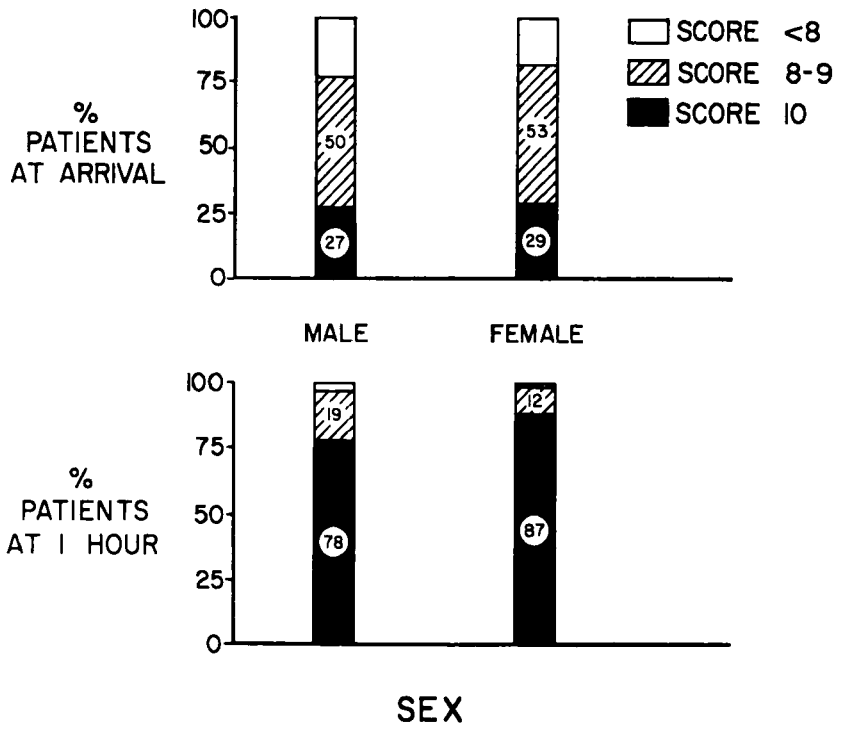

FIG. 5. Sex did not appear to influence the scores.

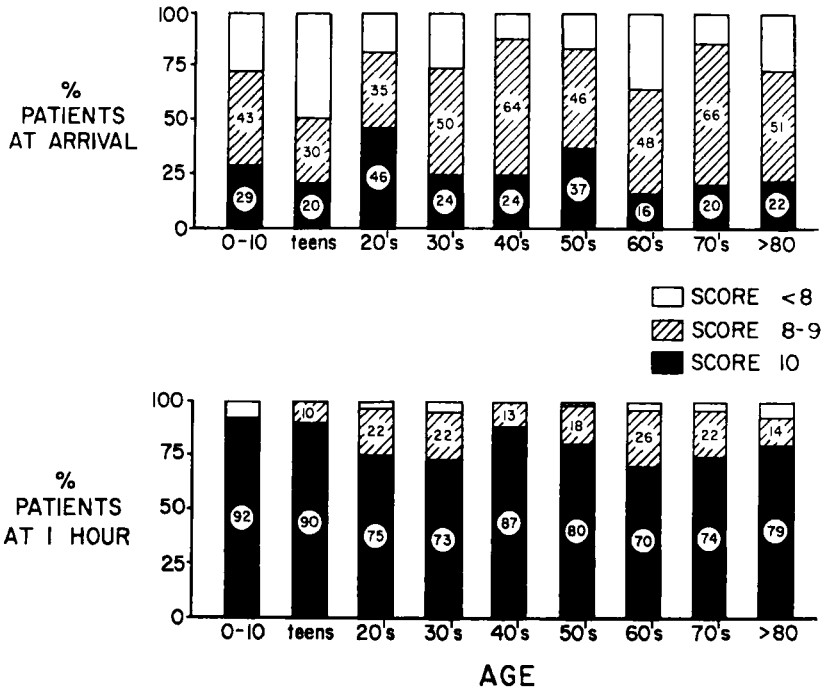

FIG. 6. No significant trend was observed where the age of the studied patients was divided by decades.

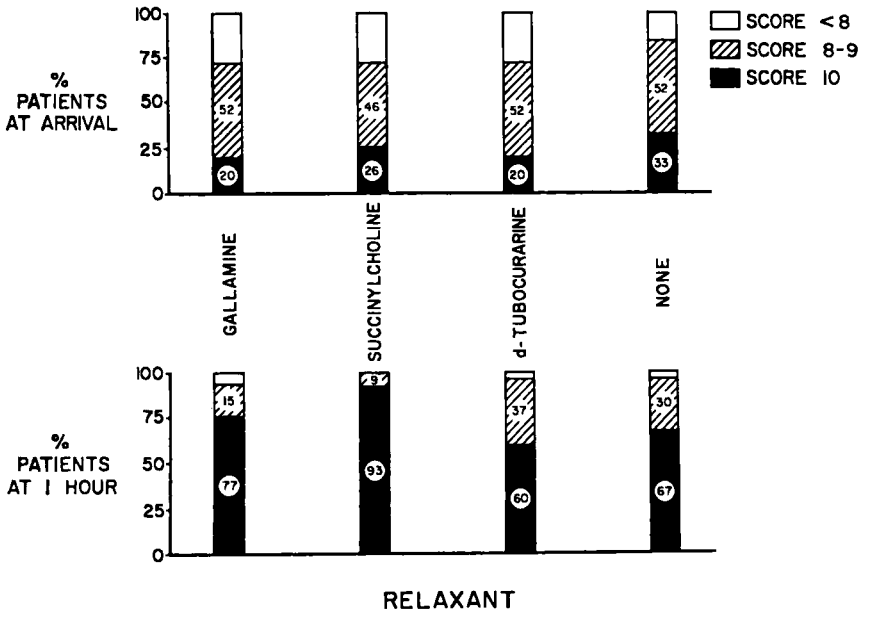

FIG. 7. Correlation of the scores attained at arrival and at one hour of stay in the Recovery Room, with the groups of patients receiving inhalation anesthesia with or without muscle relaxant drugs.

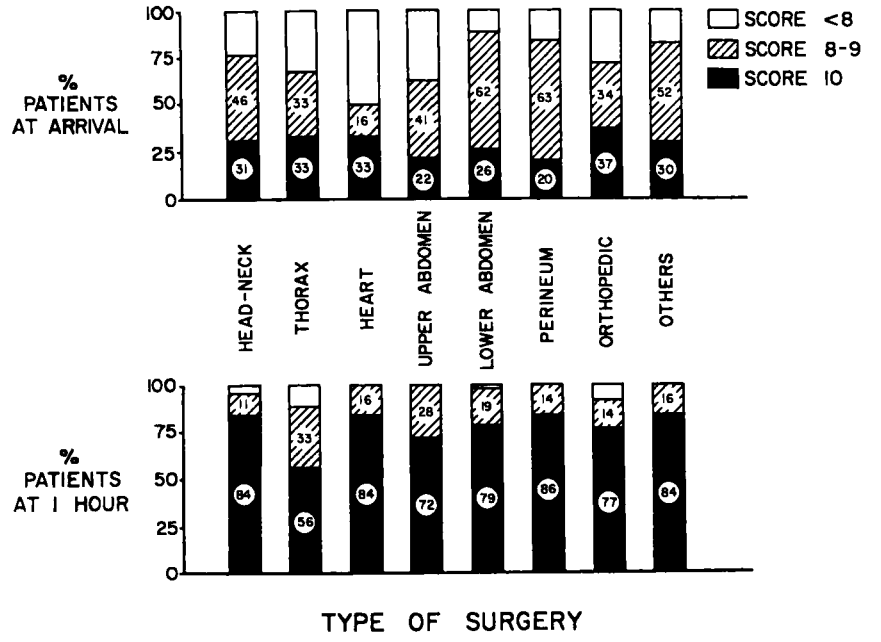

FIG. 8. Influence of the type of surgery sustained by these patients on the total scores observed.

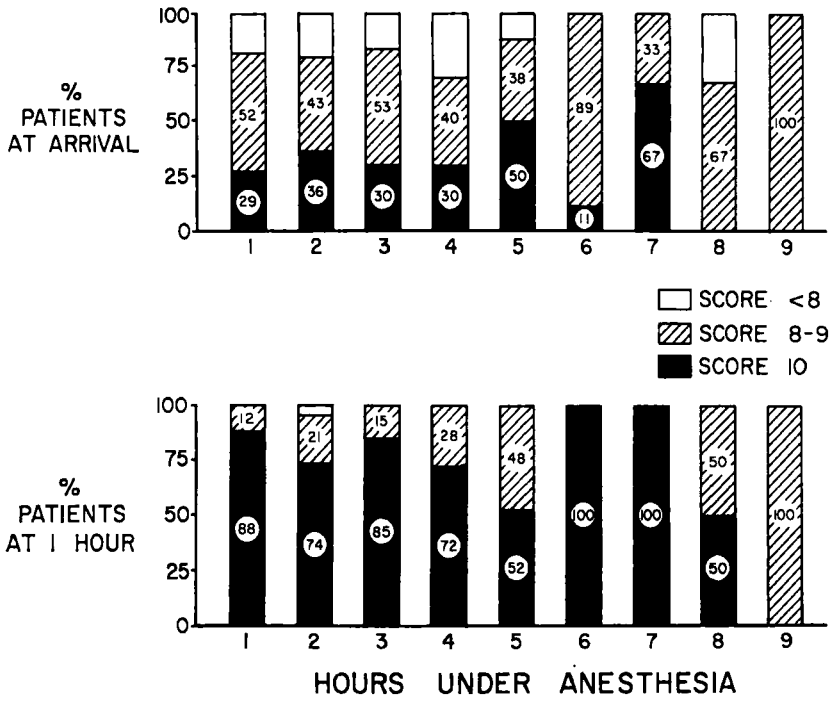

FIG. 9. When the duration of anesthesia was considered, few patients undergoing anesthesia for longer than 6 hours had scores of 10.

DISCUSSION

The ideal anesthetic agent remains undiscovered; hypothetically, it will be the compound devoid of toxicity which provides immediate onset of surgical anesthesia and the desired muscle relaxation without depressing cardiovascular, respiratory, or other vital functions. Furthermore, it should be eliminated rapidly after being discontinued, with the patient awakening without side-effects, yet nevertheless provide postoperative analgesia.

Currently, such an agent is nowhere in sight, although several intravenous and inhalation anesthetic agents possess some of these properties. The current inhalational agents depress some of the systemic functions when adequate anesthetic depth is attained. On the other hand, the newer intravenous drugs appear to spare the circulation and respiration, but to a certain degree their metabolism depends upon hepatic and/or renal functions; therefore, some of their effects on patients are longer lasting than their anesthetic action.

Other variables, rather than the anesthetic agent per se, can influence the patient's condition on emergence from the anesthetic state. Among these are preoperative physical status, the type of surgery performed, the duration of anesthesia and surgery, the severity of the operation and, of course, the skill and knowledge of the person administering the anesthetic. The latter factor will undoubtedly be reflected in the immediate postoperative status of the patient.

At optimum, a score of 10 should be present in every patient; however, this is many times impossible. Nevertheless, at the third evaluation, after 2 hours in the recovery room, the majority of the patients included in this study had attained either a score of 10 (75 percent), 9 (16.7 percent), or 8 (8.3 percent). A significant increase was seen in the proportion of patients receiving scores of 10 from the time of entrance to the recovery room to when they were evaluated for the second time, thus demonstrating the reliability of this score in assessing the gradual recovery from anesthesia.

No significant differences were observed with the various anesthetic agents. At the first and second evaluations, however, an apparent trend was noted in the group of patients receiving intravenous anesthetic agents exclusively (fig. 3). At arrival in the recovery room, the highest proportion of patients receiving scores of 10 (55 percent)

were noted; paradoxically, the lowest percentage of high scores was seen in this group 1 hour later. This finding suggests that patients anesthetized by the intravenous route were either in good condition initially because they received a small dose of an evanescent drug for a short procedure, or that repeated doses were necessary to provide adequate anesthesia for a procedure that was prolonged more than was expected; thus a depressed patient ensued.

The groups of patients receiving either subarachnoid or peridural blocks had greater percentages of high scores (fig. 3). A higher number of 10s in the peridural blocks probably reflected a lower degree of motor paralysis of the lower limbs.

No obvious difference was seen in the scores given to patients with various physical conditions except for a marked lower percentage of high scores in class IV patients at 1 hour of recovery room stay (fig. 4). Neither definite trend was noted when the age by decades and sex were correlated with the scores given.

As expected, a difference was found when the first scores of patients who received muscle relaxant drugs were compared with those awarded to patients receiving general anesthesia but without muscle relaxants. At recovery room entrance, the groups of patients given relaxing agents had a greater percentage of scores 7 or lower than the group without relaxants (fig. 7). However, 1 hour later, the difference was nil. Patients who received d-tubocurarine had, in the first evaluation, the same proportion of scores of 10 as those given gallamine, both being less than in the other two groups. This finding could be attributed to the duration of action of the nondepolarizing drugs, but would, of course, be dependent on the dose schedule and degree of antagonizing effect attained by the administration of anticholinesterase drugs.

The findings noted with the different types of surgery confirm the empiric longstanding observation that patients having thoracic (including cardiac) and upper abdominal surgery have somewhat similar postoperative evolution, with nearly equal chances for postoperative morbidity, since incisional pain in these cases may interfere with adequate respiratory function. When the second evaluation was conducted, these differences were less obvious (fig. 8).

There were no scores of 10 given to patients who were under anesthesia for 8 or 9 hours. No other consistency was noted when patients were first evaluated. One hour later, the latter group still had no scores of 10 awarded (fig. 9).

Other interesting observations were made as more experience was gained. With few exceptions, patients with scores of 7 or less were not in satisfactory condition for discharge to the ward; therefore, continuation of close observation either in the Recovery Room or the Intensive Care Unit was required.

The serial evaluation of patients with this score provided recovery room personnel with objective guidance for assessing the progress in the recuperation process from the anesthetic and surgical procedures. For this reason, this scoring system has been accepted with great enthusiasm by all nursing personnel in the hospitals where it has been used.

Also, we noted that when it was known that scores were being taken, the persons administering the anesthetics made an obvious effort to deliver the patients to the recovery room in optimal condition, thus aiming to attain higher scores.

Seldom was a score of 8 attained with four 2s, since the awarding of a 0 to one of the physical signs usually was accompanied by the grading of 1 in at least one of the other parameters evaluated.

Other areas to which this score may be applicable are in evaluating patients recovering from cardiopulmonary arrest, drug overdosage, multiple trauma, etc. In the future, factors such as the administration of analgesic agents, analeptics, nasal oxygen, and others used in the recovery room could be evaluated. Also, perhaps, evaluations at 30-minute intervals may be more meaningful than the 1-hour periods used for this study.

As reluctant as one may be to replace words by numbers, it is hoped that the general acceptance of this score (PARS) may provide guidelines for standardization of recovery room therapeutic measures, and allow a most objective comparison from patient to patient and hospital to hospital. As more experience is attained, this method of evaluation of patients recovering from anesthesia and surgery will probably be modified. From this, its first assessment, it appears that it is a reliable and practical

way to evaluate the physical status of patients as they leave the operating room, and to follow their progress in the recovery room before being discharged into the ward.

SUMMARY

A method is proposed by which the physical condition of patients immediately after anesthesia can be rapidly and simply evaluated. Analogous to the universally-adopted Apgar score, activity, respiration, circulation, state of consciousness, and color are scored and totaled numerically.

In this series, 352 patients recovering from different anesthetic procedures were studied. Their sex, age, preoperative physical status, type of surgery, and duration of anesthesia were considered. The various anesthetic agents and muscle relaxant drugs used were also evaluated. Progressively higher scores were noted as the period of observation varied from 0 to 3 hours of stay in the recovery room.

Ideally, all patients should have scores of 10, but totals of 8 or 9 were noted to be acceptable for discharge from the recovery room. Total scores of 7 or less were, in most cases, indications for continuous close observation.

ACKNOWLEDGMENT

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Guest Discussion

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During the decades past, we have solved many of the problems of the operating room with predictable, rapid, pleasant anesthetic induction, airway control against hypoxia, hypercarbia, and aspiration, temperature and blood pressure control, establishment of muscular relaxation, and maintenance of operative optimal facility and reversible pharmacodynamics of many of the toxic agents.

However, many of these superb achievements have shifted the problem and dangers for the patient to the recovery room. Happily, they are collected here as a significant achievement, replacing their dispersion throughout the hospital of a quarter century ago. In the recovery room the patient remains under the care of the experienced expert.

Medicine, and especially obstetrics, related anesthesiology, and pediatrics are indebted to Dr. Virginia Apgar for her practical, and now universally accepted, guide to scoring the vital system's responses of the newborn. Dr. Aldrete and Dr. Kroulik have wisely extended these evaluations as an immediately accepted and practical monitoring system for postanesthesia-room surveillance. The full acceptance and application of this method will improve the parameters of patient safety. It will immediately improve the meaning of assessment of patient recovery from anesthesia by nurses in this area of service. A numbered system from 1 to 10 digits is more easily understood than adjectives: "going downhill," "shocky," "a little better," "weaker," "losing ground," "shallow respiration." In fact, this easily-learned system will make recovery room nursing more interesting and more scientific with its definitive guidelines of patients' discharge to either their own rooms or to intensive care rooms.

Of greater importance, this system becomes a research tool for evaluating drugs and anesthetics, technics, risks of anesthetics, and surgical procedures, in patients of varying age and physical status. It can grade the improvement in progress of students and residents whose increasing experience and skills and understanding of

agents and technics which will be increasingly reflected in improved scores of their patients, at least in the first recovery room record.

But more importantly, here is a method of value not only to the practical security of the individual patient, but also as a public health tool to evaluate entire populations of patients and departmental performance year by year. It may be equally valuable in grading patients' recovery from disease.

The fact that this study was made in the Denver-Rocky Mountain area at an altitude of 5600 feet, or 1-mile altitude, makes us wonder how well a comparable series of patients would respond at sea level or at altitudes of 10,000 feet. I have just returned from administering anesthesia in La Paz, Boliva, at 13,800 feet altitude, and I can assure you there are significant differences in anesthesia responses of the gases and vapors, and anesthesia machines at this altitude. When we consider that more than 2 million people live at altitudes of 10,000 or more feet, here is a real area for such measurements of recovery.

Once we know the baseline of PAR scores for standard agents and technics from significant studies, in many clinics under different challenges of altitude, hemoglobin variations, temperature and fluid balance variations, race and socioeconomic status, we can better assess the advantages and disadvantages of different new anesthetic and analgesic agents in critical early trials.

I predict an early interest and application of the Aldrete-Kroulik scores with due credit to Apgar. Perhaps with the use of the interplay of words in thanking both Dr. Aldrete and Dr. Kroulik, we can give credit to both authors by designating this score from monitoring the return of the patient to A.O.K. condition.

A man is called selfish, not for pursuing his own good, but for neglecting his neighbor's.

—*Richard Whately*

* * *

It is astonishing what force, purity and wisdom it requires for a human being to keep clear of falsehoods.

—*Margaret Fuller*