POSTANESTHETIC (POSTOPERATIVE) EMOTIONAL RESPONSES

Nathan Schnaper, M.D.

The emotional sequelae to anesthesia and operation were at one time lumped together as "postoperative psychoses," regardless of interval of onset and variety of symptom. Now, it is of importance diagnostically and therapeutically, whether the appearance of symptoms is immediate or delayed, and it is necessary to determine the meaning of the symptom or symptom complex. The immediate reactions are discussed by Eckenhoff, Kneale and Dripps in this symposium. Delayed reactions are those occurring after the patient has recovered from anesthesia, with onset hours or days or even weeks postoperatively.

It was not too long ago, that all postoperative complications, organic and functional, were caused by "collections of pus." Unfortunately, this can and does happen. From time to time, patients postoperatively manifest a psychosis secondary to toxic absorption. However, this is but a minute consideration in the complex emotional cause and effect observed today.

In the context of this paper, emotional response includes psychotic, neurotic and behavioral reactions to the real or fancied threat of anesthesia and operation. Any effort to understand these emotional responses must be predicated upon the following facts: that people do have personalities (character formations); that there are different personalities; that people are more alike in their differences; and that each person brings to operation his own personality with which he defends himself against both the operation and the illness necessitating the operation.

With this in mind we can approach our understanding of the patient by considering: (1) his preoperative personality and how it is dynamically developed; (2) the meaning of anesthesia and operation to him as viewed through his personality development; (3) his postanesthetic (postoperative) emotional complications; and (4) the management of these complications in the light of present psychiatric knowledge.

Development of the Preoperative Personality

There are many Freudian concepts which are no longer limited to the psychoanalytic-psychiatric domain, but are now part of our everyday culture. For our purposes, three pertinent concepts are the unconscious, transference and defenses. One sees the unconscious revealed in dreams, slips of the tongue, mental symptoms and hypnosis. One sees these more readily in others than himself. The unconscious retains all memories, impulses and the emotions associated with these experiences. It is timeless, with little regard for reality, and therefore condones contrary wishes without doubts or negation. (Postanesthetic dreams frequently reveal unopposed wishes for both life and death.) The more painful, shameful or disgusting an experience is, the more likely it is to be repressed. This tremendous energy source determines one's psychic behavior and arbitrarily compels and impels the individual to react in current situations in a repetitious and at times irrational way. Transference also reflects the unconsciousness, and one responds emotionally to important people as he did to father, mother, siblings and other significant persons in his childhood. This concept has obvious ramifications in the doctor-patient relationship.

Man at all times seeks to maintain an outer equilibrium with his environment and at the same time an inner homeostasis. He can put on a coat to counteract the cold weather and simultaneously constrict his peripheral vasculature. These are physical and physiological defenses. Man also copes with his anxieties in his environment and in himself with a system of defenses. Anxiety is an unpleasant feeling of apprehension with its only-too-familiar somatic accompaniment. In a situation where one experiences conflict or threat of
POSTANESTHETIC EMOTIONAL RESPONSES

loss of love, security, self-esteem or personal injury, anxiety signals the defensive process. This process can be healthy or pathological, and the defenses used begin in earliest childhood and develop experientially. The child finds himself in a stressful situation. He experiments with various defenses to deal with his anxiety. One works, and he continues to utilize this defense in other situations, until it becomes an automatic way of dealing with environment and people, and permits him to feel comfortable “inside.”

Thus, “character” is formed by a predominant defense or group of defenses upon which is superimposed culture and life’s successes, failures, disappointments, talents and tempers. This is labeled personality.

These “mechanisms of defense” flourish in the unconscious and for the most part are “normal.” Occasionally, a defense is used inappropriately, or it serves to inhibit constructive utilization of the personality. Denial is an unconscious defense that prevents one from seeing that which is unpleasant, particularly about himself. The use of this defense can spare one pain, as in the case of a doctor who is being treated for cancer. He cannot arrive at the correct diagnosis, despite his being treated by radiation. Conversely, denial is used pathologically by patients who delay diagnosis and operation. Projection is a mechanism by which one’s true feelings are unconsciously attributed to another person. The patient may fear the anesthesiologist, and after the experience be resentful. When the patient receives his bill, he feels the doctor is “charging me a high fee because he doesn’t like me.” Another defense is displacement, whereby the object of the feeling is changed, rather than the emotion. The child who experiences a mask thrust upon his face, retaliates not to the anesthesiologist, but to his sibling or playmate. Other defense mechanisms are: Repression (unconscious forgetting), suppression (conscious forgetting), regression (reversion to an earlier developmental stage; e.g., the preoperatively “mature” patient who reacts to surgical stress by becoming childlike in his dependency), rationalization (excuses that seem to make sense), magical thinking (fantasies of impossible power in oneself or in others; e.g., expecting the doctor to be omnipotent), reaction formation (acting out the opposite of an impulse; e.g., the host of a cruel impulse becomes an antivivisectionist) and sublimation (an objectionable impulse directed into a socially acceptable channel; e.g., a child with forbidden destructive urges becomes a superb surgeon).

Thus, the patient approaches anesthesia and operation with self-protective resources which he can use passively or aggressively. This, in combination with his own particular developmental history gives substance and structure to his perception of anesthesia and operation as an experience.

THE MEANING OF ANESTHESIA AND OPERATION

Deutsch has thoroughly investigated the deeper meanings of anesthesia and operation in the context of the psychology of the individual personality. Realistically to all people, the operation per se implies a threat of danger—perhaps to life itself; preoccupation with the amount of suffering to be expected; the chances of cure; and concern for the diseased organ which has been invested with much emotional energy.

Symbolically, the experience has meaning in terms of the (1) anesthesia and (2) the bloody surgical attack itself. Narcosis and its loss of consciousness is seen as sleep, fainting or going away, all equating with going away from life—death. The operation signifies the threat of injury or loss of a body part. Anxiety of a special type is evoked—“castration anxiety,” an early fear of losing a part of the body. In both situations, anesthesia and operation, the response of the patient follows infantile development as derived from coping with earlier anxiety. The earliest anxiety is fear of separation, fear of being alone or abandoned—the prototype of fear of death. The second anxiety is fear of punishment, “castration anxiety.” To some patients, death and castration may be perceived as identical.

Deutsch makes the point that the attitude of the adult is based on childhood experiences. Men tend to view operation as castration. Women experience operation as delivery, with all the fears and anxieties pertaining to the birth of a child. Birth is the creator of
life; and death, the annihilator of life. This can be complicated by her relationship to her mother. If there are unconscious death wishes toward the latter, guilt and depression ensue.

If the child is struggling with masturbation or death wishes toward a parent at the time of operation, the procedure is seen as a punitive attack. Jesseam et al. observed 1:3 children before, during and after tonsillectomy with follow-up, rather than retrospectively. They found that anesthesia conveyed a threat of death equating with separation from mother to some children. Others expressed various meanings such as punishment, murderous or sexual attack, fear of loss of control over the environment or over their impulses. The operation per se meant mutilation or castration; changing the boy into a girl or vice versa; exorcism; giving birth (in girls, but some boys as well); and misconstruing the tonsillectomy as some other surgical procedure overheard elsewhere. Despite the fantastic notions, 80 per cent of the children fared well, a few even improving their emotional adjustment. Narcosis was feared most in the ten to fourteen year age group.

Spinal anesthesia and peripheral surgery may be perceived as threat of castration; whereas surgery on deeper organs means threat of death. Anesthetic “sleep” represents not only the realization of the fear of death, but also the unconscious wish for death (return to mother and reunion with her). After anesthesia, if the wish for death was strong, the patient may awaken in an exhilarated, reborn state or a depressed one, still wishing to die.

Herein may be a psychological clue to “emergence excitement,” with all degrees of “glad to be alive,” from euphoria to psychotic mania, varying with the patient’s preoperative personality. Where the castration fear is greater, the patient may awaken and “come out fighting.” These patients may have been calm and self-assured prior to anesthesia.

Menninger 5 considers the question of poly-surgical addiction. He offers various motives, some cited above. Some patients practice an unconscious avoidance of something else (e.g., marriage) feared more than surgery. Others seek a dependent masochistic relationship with a surgeon seen as a strong father figure who is willing to operate. Somehow, these patients manage to find a cooperative surgeon.

Viewing the personality descriptively rather than dynamically, the full gamut of psychiatric diagnoses is observed. Zweirng et al. examined 200 randomly selected cases, 172 (86 per cent) of whom had preoperative psychiatric disorders. The diagnoses in order of incidence were: Character and behavior disorders; neuroses; psychoses; psychophysiological reactions; chronic brain syndromes and miscellaneous.

POSTANESTHETIC (POSTOPERATIVE) EMOTIONAL COMPLICATIONS

The most dramatic complication is the so-called “postoperative psychosis.” There are, indeed, psychotic reactions to be observed postoperatively, but it is not to be inferred that these reactions are caused by operation. Neither “postoperative psychosis” nor “postpartum psychosis” is a distinct etiological or nosological entity. What one observes in such situations, be it postoperatively or at any time, are emotional decompensations in the face of anxiety. When this occurs, the patient can manifest an exaggeration or seeming absence of his defenses or combinations of permutations of same. He can intensify the defense of projection and become paranoid. Or, he insists on denial of his need for operation or postoperative care. Or there is a heightened transference toward the doctors and nurses, and he clings dependently and complainingly to them, so that he may displace his resentment.

The patient who clings and complains (euphemistically the “ward nuisance,” “crock”) is the most frequent and troublesome of all the postoperative emotional complications. He is neither interesting nor dramatically psychotic, and so is dealt with by early

*Sought-for castration can be a localized self-destruction in order to preserve and sustain a personality, e.g., the transvestite having literal castration performed. A male homosexual, whom the author treated, sought symbolic castration. During his early adolescence, a temporary period of transvestism for him, he deliberately convinced a surgeon to remove his appendix.

† Suggested explanations for this high figure: stress of illness and operation; cases were from a low socioeconomic group; and patients with psychiatric disorders had more operations.
discharge. Until then, he is avoided, cursed by doctors, nurses and attendants, and the more he is, the more he clings. The problem is bilateral. The patient is not seeking “attention,” for no amount of secondary gain will compensate for the “assault and robbery” to his body.† If he can extract interest from the staff, then he unconsciously experiences some recompense. He tries too hard to be “nice,” but his resentment is felt by the entire staff and they, in turn, retaliate by hostile techniques outside of their awareness.

Perhaps of even greater concern are the preoperatively calm, non-anxious, “good” patients. These usually become disturbed, or disturbing, postoperatively. Janis, through psychoanalytic case studies and survey research, found a curvilinear relationship “between the level of anticipatory fear and subsequent adjustment to stress” (surgical experience). Patients displaying a moderate degree of anticipatory fear will be less likely to develop emotional disturbances during and after stress exposure than those displaying a very high or very low degree of anticipatory fear. Patients who manifest a high level of anticipatory anxiety will be more likely than others to display intense fear of bodily damage during stress. Patients who display a very low level of anticipatory fear or anxiety will be more likely than others to display anger and resentment toward authorities in the period following stress.

Lindemann, in his experience with 51 patients, found that those who are very apprehensive are not necessarily poor risks. Anxiety alerts the individual’s inner defenses, the person is “on guard,” danger is anticipated, and he is neither shocked nor overwhelmed. In a sense the anticipatory anxiety serves as an immunizing process and defenses are mobilized.

Specific Postoperative Psychiatric Syndromes. Clinically, the full spectrum of psychiatric syndromes from the organic through the functional can be observed. The following classification may prove useful: 10

Brain Syndrome—may be acute or chronic, resulting from impairment of cerebral tissue

† He did observe that females in the hospital for pelvic operations and/or with previous depressions are prone to depressions. function. Underlying pathology may be toxic (chemical or infectious), traumatic, disease, metabolic, or congenital. Symptoms reflect a basic sensorial defect; impairment of orientation, memory, all intellectual functions, judgment and ability of affect. These symptoms have individual coloring supplied by the patient’s previous personality. “Acute delirium,” or “delirium state,” is the commonest subgroup of Acute Brain Syndrome encountered. It is reversible, and the patient experiences terror and at times, panic. The symptoms such as hallucinations, delusions, illusions and behavioral disturbances are secondary to the basic sensorial derangement.

Manic Depressive Reaction—a functional disorder characterized by moderate to severe mood swings, and by remission and recurrence. Delusions, illusions and hallucinations and violent anger to the slightest frustration are superimposed upon one or the other mood alteration.

Psychotic Depressive Reaction—severely depressed ideation and mood, psychomotor retardation, with gross misinterpretation of reality. Suicidal.

Schizophrenic Reactions—a functional psychotic disturbance, marked by aberrations of reality relationships and concept formations, and upon which symptoms are based. These patients retreat from reality; emotions and moods are inappropriate; behavioral and thought productions are unpredictable. Secondary symptomatology includes delusions and hallucinations of varying type and degree. The most frequent type observed postoperatively is paranoid, with delusions of persecution and/or grandeur and hostile and aggressive behavior. Religiosity is common.

The following are the more familiar of the psychoneurotic emotional responses complicating the patient’s postoperative career:

Anxiety Reaction (“anxiety state”)—the anxiety is uncontrolled, as no immediate defenses are available to the organism. The fear is diffuse and not confined to specific objects or situations, and the patient expresses anxious expectation and somatic complaints.

Conversion Reaction (“conversion hysteria”)—the anxiety is not experienced consciously, but is “converted” into symptoms in
organs or other parts of the body with a resultant loss of function (anesthesia, paralysis, dyskinesia). Thus "felt" anxiety is lessened and the underlying conflict is symbolized in the symptoms. (These differ from "psychosomatic" symptoms, in that the latter are physiological rather than symbolic, involve viscera supplied by the autonomic nervous system, and produce organ pathology which may threaten life.)

**Depressive Reaction**—the anxiety is allayed and partially relieved by guilt, self-deprecation and depression. The reaction is precipitated by a real or fancied loss, physical or emotional. Although this reaction can be intense enough to eventuate in suicide, it differs from the Psychotic Depressive Reaction in that the capacity to test reality is retained.

**Psychiatric Patterns Associated with Specific Entities.** Occasionally, psychiatric patterns are found associated with specific medical or surgical entities. As indicated earlier, this is brought about because the patient invests so much emotional energy in his diseased organ. The loss of a hand obviously means more to the violinist than to the worker, but the impact is reversed if a toe is amputated. The importance of eye or ear surgery is clear when one considers how necessary these organs are in coping with the environment. To this, there is superimposed the threat to voluntary control when the patient relinquishes the function of these organs to anesthesia. In the same vein unnecessary cystoscopic manipulations for enuresis, circumcisions to "cure" masturbation in the male or frigidity in the female are interpreted as threatening and punitive. Surgery of the breast is seen as disfiguring to the individual's body image and narcissism.

Cancer patients see themselves as helpless, "washing away," suffering and dying from something "unclean." They feel guilty and attribute the cause of their illness to sin, venereal disease, contagion and inheritance. This results in a delay in seeking treatment and a dejected sense of inferiority and inadequacy. Surgery implies to them the disruption to performance that the loss of the organ entails. They are depressed for this reason and from the fear of isolation and unacceptable. They can become suspicious to the point of being paranoid.

It should be kept in mind that these patients also had childhood experiences, and currently also have wives, husbands, children and reality problems. Needless to say, they can also have brain syndromes due to cerebral metastases and secondary toxic absorption.

Plastic surgery, although rampant with psychiatric nuances and sequelae, manifests delayed postoperative complications. Initially, the patient is elated with his or her improved self-image and confidence. In time, this moderates or disappears as a sexual involvement or situational maladjustment occurs. The problem is not to operate on everyone who requests plastic surgery. Motivation, psychiatric history and expectations have to be considered in every case.

Surgery for the treatment of tuberculosis is fraught with complications. Stress is superimposed on already existing stress. Operation is fantasied as being subjected to the domination of powerful parental figures whose help is sought and feared. Common symptoms are: anxiety, depression, defiance, elation, over-dependency, resentment and uneasiness. The anesthesiologist has two roles here. First, he administers the anesthetic. Secondly by his contacts with the patient he dispels the patient’s apprehension and feeling of shame and stigma about himself and his disease.

Catarrhal extractions, particularly in the aged, are followed by emotional disturbances in 3 per cent of operated cases. This is higher than the statistics in general surgery. Bandaging of the eyes results in a loss of orientation and security. Panic, confusion and even hallucinations ensue. These sensory hallucinations are similar to those in "phantom limb" patients. These hallucinations are comparable to those produced by mescaline.

The alcoholic and the narcotic addict offer problems to the anesthetic procedure as well as postoperatively. Symptoms develop subsequent to withdrawal in both cases. The alcoholic's delirium with its hallucinations can appear as the anesthetic leaves his body or may follow a febrile episode as late as two weeks, postoperatively. The narcotic addict has little difficulty if his preoperative or post-
operative medication relates to his addiction. If it does not and he is conscious, he will soon inform his doctor or have "the junk sent in." However, disturbances will develop if he is semiconscious or unconscious when "withdrawal" occurs.

MANAGEMENT OF EMOTIONAL COMPLICATIONS

Unquestionably, the management of complications begins with prevention. In this direction, preoperative psychological preparation of the patient is urgent.\textsuperscript{3, 5, 7, 20, 21} This is accomplished not only by the surgeon's efforts, but must include a preanaesthetic visit by the anesthesiologist.\textsuperscript{22}

Recognition that the patient has a psyche is not new, but the manner of dealing with his emotions is. Witness the valor of one particular surgeon at the turn of the century. Mears,\textsuperscript{23} in 1912, wrote a monograph describing his earlier treatment of three patients with "neuropathic" problems. The first patient, an 18 year old girl with an ostensible abdominal tumor and an ankyllosed knee, was examined at home under ether anesthesia. (She demanded and thought chloroform was being administered.) There was no evidence of tumor or ankylosis. He then treated her with massage, exercise and suggestion. The second patient insisted on removal of uterine "stumps." She was anesthetized and her abdomen scratched with a scalpel and massive bandages applied. The third patient suffered generalized seizures which she felt originated in her right thumb. She demanded that her entire right hand be amputated. This was done \textit{without} anesthesia, as per her request, and she watched each detail with great interest. In each case, success was reported, so how can one look askance at his technique?

Today, we are more conservative, but this is because we are more knowledgeable. We are aware that the patient's emotional upheaval postoperatively has to do with his deploying his defenses against a stressful onslaught. This insight takes the patient's behavior out of the realm of the mysterious. This does not mean that because a patient might view spinal anesthesia as castration, that all patients should have general anesthesia. Nor does it necessarily imply that this particular patient should have a general. These are fantasies on the patient's part, and it is imperative that the anesthesiologist and surgeon remain on the side of reality and do what is medically best for the patient. However, if the patient's anxiety state, for example, is disruptive to his best interests, and he is complaining about a spinal, the procedure may be changed to a general. But this decision should be based on the anesthesiologists' judgment and evaluation of the patient's defenses or lack of them, rather than on the patient's fantasies.\textsuperscript{\$}

A useful rule of thumb is: If an anesthetic or operative procedure should be done, then it is, regardless of the patient's emotional state. The psychiatric sequelae can be considered subsequently. Psychotherapy is of no avail to a dead patient. A psychotic patient with a "hot appendix" is a patient with acute appendicitis \textit{first} and should be treated accordingly.\# If he is catatonic, treaectomy might be advisable. Drugs used in the treatment of the psychosis should be continued, unless physiologically incompatible. If the latter prevails, temporary discontinuance would not affect matters. Drugs, as part of the anesthetic procedure, have the same influence on the "emotional" as on the "normal," as long as judicious usage is maintained.\textsuperscript{24}

Some words of caution concerning medications for the aged. They are prone to confusion postanesthetically and need attention and support.\textsuperscript{4} In the writer's experience, barbiturates further the confusion already present in older people. They work hard at orienting themselves with what sensorium is intact. Narcotics and barbiturates blunt their faculties and disorientation results. If these drugs are necessary, they should be administered in smaller doses. Because their digestion and absorption are usually impaired, the

\textsuperscript{\$} Regrettably, there are times when medical judgment must defer to the fantasies for medico-legal reasons. This is one of the grim realities of life.

\textsuperscript{\#} It has been empirically noted that psychotics undergoing anesthesia, with or without operation, frequently enter a period of remission, usually short-lived. One explanation is that the energy utilized by the psychosis is temporarily "bounf" to defending against the unprepared-for stimulus (forced unconsciousness).
mode of administration should be parenterally. If given orally, it should be in liquid form, as pills and capsules frequently pass through the intestinal tract unchanged. A useful drug is chloral hydrate. The same general consideration applies to ophthalmic surgery. Bandaging the eyes affects orientation and early uncovering of the unoperated eye is essential.

The depressed patient, with his sadness, disturbed sleep and spontaneous tears, needs to be met frankly and with sympathy. He should be permitted to ventilate to the anesthesiologist and the surgeon, and they can clarify his reactions to his experience.

The group of patients who are not psychotic or obviously neurotic and who disturb their environment with their demands are more difficult to manage. Preoperative predictability is uncertain. The low anticipatory fear patients are inclined to be disturbing, postoperatively. The patient who with inordinate emotion insists on operation or type of anesthetic procedure is prone to physical as well as emotional complications. Also, there are some patients whose anesthetic and operative procedures have been entirely successful, and then have untoward reactions physically and emotionally. As an example, following successful surgery for hypertension, the patient becomes depressed. These people have an emotional need for their illnesses, which serve a defensive function for them. The chronic lesions are in this category.

What can the anesthesiologist do when faced with a postanesthetic (postoperative) emotional complication? Prompt attention to the patient postanesthetically with assurance, encouragement and orientation is important. In support of this, time and patience and a comprehension of the wholeness of the personality are necessary.

The anesthesiologist with a dynamic, rather than descriptive, understanding of the personality can function as a psychotherapist. With a conceptual understanding of the unconscious process he can see sense and logic in the patient’s seemingly meaningless behavior. He can then deal with the conscious verbal production of the patient, leaving the interpretations of the unconscious to the specialist. The patient, then, is offered assurance, reassurance, clarification, support, firmness when necessary, sympathy when indicated—each in an objective, reality-oriented way. The anesthesiologist’s armamentarium is such that he has the capacity to breathe for the patient, feed the patient and spare his physical pain. Today he can add to these his insight, which is the patient’s pathway to an emotionally comfortable operative course.

REFERENCES


** Hypnotism used as an anesthetic technique—"anaestheticist"—is not construed as psychotherapy.
15. Linn, L., and Goldman, I. B.: Psychiatric observations concerning rhinoplasty, Psycho-
17. Lane, E. W.: The Tuberculosis Patient’s Pri-
    vate World; and Adriani, J.: Psychosomatic
    Aspects of Chest Surgery for Pulmonary
    Tuberculosis, In Personality, Stress and Tu-
    berculosis. Edited by Spencer, P. J., New
    York, International Universities Press, Inc.,
18. Preu, P. W., and Guida, F. P.: Psychoses com-
    plicating recovery from extraction of cata-
19. Bartlet, J. E.: Case of organized visual halluci-
    nations in old man with catarrh, and their
    relation to phenomenon of phantom limb,
    Brain 74: 363, 1951.
20. Ebaugh, F. G.: Psychiatrist in relation to sur-
21. Meyer, B.: Some psychiatric aspects of sur-
23. Mears, J. E.: Surgical Psychoses. Phila-
    delphia, William J. Dorman, 1912, pp. 1-
    16.
24. Cobb, S., and McDermott, N. T.: Postoperati-
25. Doyle, J. B.: Postanesthetic and postoperative
26. Lipkin, M., and Joseph, E.: Some psycho-
    somatic aspects of management of surgical
27. Schaefer, J. A.: Psychosomatic factors in sur-

BIBLIOGRAPHY
1. Cantor, A., and Foxe, A. N., Editors: Psy-
    chosomatic Aspects of Surgery. New York,
    Grune & Stratton, 1956.
2. Dunbar, F.: Psychiatry in the Medical
    Specialties. New York, Blakiston Division
3. Ficara, B. J.: A Psychosomatic Approach to
    1951.
    New York, International Universities Press,
    1949.
5. Levy, D.: Psychic trauma of operations in
    operations on integrative functions of the
    ego, Psychoanal. Quart. 20: 77, 1951.
7. Mittleman, B.: Psychoanalytic observations on
    dreams and psychosomatic reactions in re-
    sponse to hypnotics and anesthetics,
8. Titchener, J. L.: Surgery as a Human Ex-
    perience. New York, Oxford University
9. Weiss, E., and English, O. S.: Psycho-
    somatic Medicine, ed. 2. Philadelphia,
    W. B. Saunders Co., 1949.

NARCOTICS AND ANTAGONISTS The effects of morphine, meperidine and levallor-
phan on the respiratory movements and on the various components of the central respiratory
mechanisms were studied in thirty-five vagotomized and decerebrate cats. Morphine and meperidine depressed the responsiveness of the medullary respiratory centers to electrical
stimulation. The activity of the two narcotics was principally one of affecting the respira-
tory rate. At the dose levels studied this effect was more pronounced with morphine
than with meperidine. Meperidine tended to reduce the amplitude of respiration more per-
sistently and to cause respiratory irregularity. At the dose levels studied, neither drug seemed to impair the recruiting mechanism. The pontile apneustic center was also depressed by both drugs. Levallorphan, when used as an antagonist, had its main action in restoring respiratory rhythmicity. (Ngai, S. H.: Effects of
Morphine and Meperidine on Central Re-
spiratory Mechanisms in Cat; Action of Lecal-
lorphan in Antagonizing These Effects, J.
Pharmacol. Exp. Ther. 131: 91 (Jan.) 1961.)