

Chloroform as a Counter-Irritant.—When chloroform is applied to the skin and evaporation prevented, it causes heat, redness, and even vesication. Frequently, chloroform is used locally to produce this effect, but usually in combination with other counter-irritants. ℞ Chloroformi, ol. terebinthinæ, āā ℥j; lin. saponis, ℥ij. M. Sig.: *Liniment.* ℞ Chloroformi, lin. camphoræ, āā ℥j. M. Sig.: *Liniment.* These are elegant counter-irritant applications, in cases requiring the milder remedies of this class, and are used in various internal inflammations and local affections characterized by pain. Commercial chloroform can be used in preparing them.

Chlorodyne.—This empirical preparation is largely used in cholera, and in painful diseases requiring an anodyne. Numerous formulæ have been published, but none of them appear to possess the exact qualities of the original preparation by Dr. J. C. Browne. The dose of the genuine chlorodyne ranges from ten to thirty drops. The following formula makes a product more nearly resembling the original than any other known to the author:

Chloroform	4 ounces.
Ether	1 ounce.
Alcohol	4 ounces.
Treacle	4 ounces.
Extract of licorice	2½ ounces.
Muriate of morphine	8 grains.
Oil of peppermint	16 minims.
Sirup	17½ ounces.
Acid. hydrocyan. dil.	2 ounces.

Dissolve the muriate of morphine and the oil of peppermint in the alcohol, mix the chloroform and ether with this solution, dissolve the extract of licorice in the sirup, and add the treacle; shake these two solutions together, and add the hydrocyanic acid. Dose, five to fifteen minims.

Some of the published formulæ contain resin of cannabis Indica, atropine, perchloric acid, in addition to the ingredients above given.

Another chlorodyne, known as "Gilman's," has many advantages, and is now widely used. Its composition is as follows: ℞ Chloroformi purificati, ℥ij; glycerini, ℥ij; spts. vini rect., ℥ij; acid. hydrocyanic. dil., ℥ij; tinct. capsici, ℥ij; morphinæ muriatis, gr. viij; syrui (treacle), ℥iij. M. The dose of this chlorodyne for an adult is a *teaspoonful*. In prescribing the various mixtures known by the common name—*chlorodyne*—the strength should be ascertained before administering.

The following formulæ (Fox) are very efficacious in the local affections for which they are recommended:

℞ Chloroformi, ℥vj; cucumber cerate, ℥j. M. Sig.: *Ointment for pruritus.* ℞ Plumbi carbonat., ℥ss; chloroformi, ℥iv; ungu. aquæ rosæ, ℥j. M. Sig.: *Ointment for pruritus.* ℞ Chloroformi,

℥ viij; glycerin., ℥j; ungu. simplicis, ℥vj; potassii cyanidi, grs. iv. M. Sig.: *Ointment for pruritus.* ℞ Morphina acetat., 1 part; chloroform, 8 parts; lard, 60 parts; oil of sweet almonds, 40 parts. M. An ointment to be applied several times a day in *pruritus pudendi*.

Authorities referred to:

BARTHOLOW, DR. ROBERTS. *On the Deep Injection of Chloroform for the Relief of Tic-Douloureux.* *The Practitioner*, July, 1874, p. 9.

FOURNIER, DR. H. *Annuaire de Thérapeutique*, 1879, pp. 68-70.

FÉRÉOL, DR. *Injections Sous-cutanées de Chloroforme.* *Annuaire de Thérapeutique*, 1879, p. 68.

GUBLER, DR. ADOLPH. *Commentaires Thérapeutique du Codex Medicamentarius*, p. 670.

HUSEMANN, DR. THEODOR. *Handbuch der gesammten Arzneimittellehre*, zweiter Band, 1869.

TROUSSEAU ET PIDOUX. *Traité de Thérapeutique et Matière Médicale*, eighth edition.

ANÆSTHETICS AND ANÆSTHESIA.

Æther Fortior.—The stronger ether.

Chloroformum Purificatum.—Purified chloroform.

Neither of these anæsthetics should be used until its conformity to the standard of the United States Pharmacopœia has been ascertained. The tests of purity are given under their respective heads in the preceding article.

The term *anæsthetic*, proposed by Dr. Oliver Wendell Holmes, means an agent capable of producing *anæsthesia*, or insensibility to pain. It is true, *anæsthesia* is a term which, according to its etymological signification, should be applied to loss of sensation of touch, chiefly, and *analgesia* should be used to signify loss of the sense of pain; but the word *anæsthesia*, as expressive of the state of profound unconsciousness induced by anæsthetics, is now so firmly established by usage that it were better to retain it. Insensibility to pain (*analgesia*) may be produced, without simultaneous loss of common sensation, touch (*anæsthesia*). By the inhalation of ether, chloroform, bichloride of methylene, nitrous oxide, and some other agents, the functions of animal life can be so far suspended that surgical operations involving intense pain, and certain natural processes, accompanied by great suffering, can be performed entirely without the consciousness of the subject concerned.

PHYSIOLOGICAL ACTIONS.—When the vapor of ether or chloroform is inhaled, a sense of faucial irritation and of the need of air is experienced, and more or less cough is produced. The irritation of the fauces excites the flow of mucus, and the reflex act of swallowing. The feeling of need of air causes the patient to push aside the inhaler or sponge, and in children may lead to violent struggling. The sensibility of the glottis is soon diminished, the coughing ceases, and the inhalation then proceeds quietly.

The first effect is a general exhilaration, the pulse increases in frequency, the respirations become more rapid, and sometimes assume a sobbing or convulsive character; the face flushes; talking, laughing, crying, singing, and sometimes praying, indicate the cerebral intoxication. This stage of excitement varies in duration in different individuals, and is more pronounced in character and more persistent in those of mercurial disposition, and in the hysterical. At this period, although the patient can be easily aroused, sensibility to pain is decidedly diminished; although the sense of touch may be preserved, taste and smell are abolished, and the sight is either abnormally acute or is perverted by illusions. If the inhalation be continued, the patient passes into the condition of complete insensibility. In women and children, and males reduced by illness, the production of insensibility, if the anæsthetic be not inhaled too rapidly, takes place quietly; but, if the subject be a robust male, in full health, especially if the inhalation has been proceeded with rapidly, the stage of insensibility is preceded by a tetanic convulsive stage, in which the voluntary muscular system and the respiratory muscles become rigid, the breathing stertorous, the face cyanosed. This condition of rigidity is similar to, if not identical with, the tetanic stage of the epileptic paroxysm. If the inhalation of the anæsthetic be pushed still further, the tetanic rigidity subsides, the cyanosis disappears, the breathing proceeds quietly, and a condition of complete muscular relaxation, and of abolition of reflex movements, is established. When this is accomplished, the arm drops without resistance when let fall, the conjunctiva is insensible to irritation, the pupils do not alter in size when exposed to light, and no mechanical irritation awakens the least consciousness of pain. The surface is cool, and bathed with abundant perspiration, the countenance is placid, the eyes closed, the pupils rather contracted than dilated; the respiration easy, but more shallow than normal; the pulse slower—it may be feebler, it may be stronger than in health. The functions of the cerebrum are suspended; only the lower centers, presiding over respiration and circulation, continue in action. Out of this condition, and without interference, the patient will presently emerge. If, however, the inhalation be continued, these organic functions will be suspended, and life will be terminated by the cessation of the action of the heart and of the respiratory organs.

There are several modes of dying from anæsthetic vapors:

1. By the first mode, the death is sudden and occurs very soon after the inhalation has begun, and is ascribed to "irritation of the peripheral nervous system, accumulation of carbonic acid in the blood, and arrest of the action of the heart." This explanation, the author submits with diffidence, seems very unsatisfactory, for phenomena of this kind, up to the point of cardiac paralysis, must ensue in all cases of chloroform narcosis. The sudden death, at the beginning of inha-

lation, seems to be more properly explicable on the theory that the first chloroform vapor which reaches them paralyzes the cardiac ganglia, already in an abnormal state of susceptibility from causes not now understood, for this accident sometimes occurs in persons who have previously taken the anæsthetic without unfavorable symptoms of any kind.

2. By the second mode, called by Richardson *epileptiform syncope*, death ensues in the stage of rigidity preceding complete muscular relaxation, and is due to tetanic fixation of the respiratory muscles, and consequent interference with the pulmonary circulation, accumulation of blood on the venous side, and arrest of the heart's action. In these cases respiration ceases before the pulsations of the heart cease.

3. *By paralysis of the respiratory muscles.* Death ensues during the stage of complete muscular relaxation, and the action of the heart continues for some seconds, or even minutes, after respiration has ceased.

4. *By paralysis of the heart.* This also occurs in the course of complete insensibility; the motor ganglia are paralyzed, and the heart suddenly ceases to act, the respiration continuing for a short time longer.

5. This mode of dying is made up of two factors: *depression of the functions* by chloroform narcosis, and the shock of the accident, or the surgical operation. Death may ensue during the inhalation, or may occur afterward.

CONDITIONS OF THE ORGANISM RENDERING THE USE OF ANÆSTHETICS DANGEROUS.—Experience has demonstrated that old drunkards are peculiarly unfavorable subjects. When tumor or abscess of the brain exists, it is dangerous to administer anæsthetics. Instances of sudden death under these circumstances are relatively numerous. Very much enlarged tonsils, swollen epiglottis, œdema of the glottis, are contraindications, but not insuperable, to the use of anæsthetics. Emphysema of the lungs is so frequently accompanied by ischæmia of the arterial, and engorgement of the venous side of the systemic circulation, and with dilatation of the right cavities, that it must be considered a dangerous state in which to administer chloroform, or even ether. Fatty change in the muscular substance of the heart must be considered peculiarly unfavorable, for more deaths have ensued from this cause than any other.

Chloroform and ether have been administered with safety in cases of phthisis and heart-disease (valvular lesions), the muscular substance and its contained ganglia being free from structural change.

Experience has abundantly demonstrated that those reduced by illness and disease, and the feeble, bear anæsthetics better than the healthy and robust; that children and women are better subjects than

adults and men; that anæsthetics are safer when given for operations for disease than for injury.

Incomplete anæsthesia is a condition of danger. Numerous accidents have occurred from the use of anæsthetics for trivial operations—notably for extraction of teeth—in which but a partial degree of insensibility is induced. In such cases the heart, enfeebled by chloroform narcosis, is suddenly paralyzed by the reflex action proceeding from the peripheral injury. The district of tissue supplied by the fifth nerve is an especially dangerous region, owing doubtless to the intimate connection of the nucleus of the fifth with the nucleus of the pneumogastric. By far the largest number of fatal cases have resulted from a neglect of this rule: it is never safe to proceed in a surgical operation with anæsthetics, unless complete insensibility has been produced. The author is aware that Trousseau and Pidoux have attributed the number of cases of fatal chloroform narcosis, which have occurred in England, to the fact that the just-mentioned rule is adhered to by English surgeons. Their words are as follows: "*En Angleterre, les chirurgiens portent l'éthérisation jusqu'à l'abolition de toutes les facultés animales, jusqu'au commencement de la période d'éthérisme organique. Plus prudents sous ce rapport que leurs confrères de la Grande-Bretagne, les chirurgiens français ont l'habitude de s'arrêter dès que la sensibilité aux excitations de la peau est abolie et que la résolution musculaire commence. Cette prudence explique comment les chirurgiens français ont éprouvé moins d'accidents graves et compté moins de morts subites.*" (Vol. ii, p. 322.)

MODES OF CONDUCTING THE INHALATION.—After ascertaining that none of the contraindications mentioned above exist, the patient may be prepared for the inhalation of the anæsthetic vapor. The inhalation should not be proceeded with soon after a full meal. Vomiting, as the narcosis subsides, is usual, and, as the insensibility of the glottis persists for some time afterward, particles of food may be lodged in the chink, causing fatal suffocation. Several cases of this kind have been reported. On the other hand, it is bad practice to administer an anæsthetic after a prolonged period of fasting, for the exhaustion thereby induced may be an influential factor in determining a fatal result. Before the inhalation is begun, it is proper to administer an ounce or two of whisky or brandy. Much more important is the expedient proposed by Bernard and afterward by Nussbaum, to premise a subcutaneous injection of morphine. Bernard proposed to administer the morphine before beginning the inhalation; whereas Nussbaum used it after unconsciousness to pain had been produced. The advantages of the former method are obvious. When the morphine influence takes place, the inhalation will proceed quietly without the struggling and coughing, and spasmodic breathing, which so interfere with the administration of anæsthetics, especially of ether. The use

of morphine subcutaneously also lessens materially, if not prevents entirely, the stage of rigidity and spasm. The quantity of the anæsthetic required is much less, and the stage of insensibility more prolonged, when morphine is thus given.

Besides the foregoing conspicuous advantages derived from the preliminary subcutaneous injection of morphine, there can be no doubt that this agent antagonizes the paralyzing action of the anæsthetic on the cardiac and respiratory centers, and prevents the subsequent shock due to the administration of the anæsthetic and the performance of a surgical operation.

The proposal of Bernard, as subsequently advocated by Nussbaum, was some time afterward strongly urged by the late Prof. William Warren Greene, M. D., of Pittsfield, Massachusetts, and Dr. J. C. Reeve, of Dayton, Ohio. Soon after the publication of Bernard's observations, the author, in his "Manual of Hypodermatic Medication," proposed the use of morphine and atropine combined as more perfectly realizing the object contemplated. Since this time, at Lyons, the combination of morphine and atropine has been largely employed preliminary to ether inhalation. The method is known as "*anesthésies mixtes,*" or, anæsthesia by a mixed method (Aubert). The addition of atropine is to increase the forces of the antagonism against the depression of the cardiac and respiratory functions. The experience of the Lyons school is decidedly in favor of the method of mixed anæsthesia. Adverse reports from other quarters, however, have not been wanting, but the relevancy of their facts is doubtful.

When the anæsthetic is about to be administered, the operator should, by a cheerful and confident manner, remove the fears of the patient. None of the *parapherna* of the operation to be performed should be exhibited before the patient, and no remarks should be made in his hearing regarding his case, the anæsthetic sleep, or the surgical procedure. Only the physician having the administration of the anæsthetic in charge, and the necessary assistants, should be present in the apartment. An abundant supply of fresh air should be insured to the patient, and all the appliances required for resuscitation should be at hand, but not ostentatiously paraded before the patient.

The simplest apparatus only is required. Complicated inhalers have, as frequently as the towel or the handkerchief, been used in fatal cases of chloroform narcosis. A cone of stiff paper, lined with lint or felt, and large enough to cover the nose and mouth of the patient, is the best form of inhaler for the administration of ether. Lente's ether-inhaler consists of a cone of hard rubber lined with felt, and having attached to the apex a flexible rubber tube communicating with the ether-bottle. This is a very satisfactory apparatus. A similar but much less complicated and expensive inhaler is that of Dr. Allis, of Philadelphia. The utility and desirableness of this apparatus are