PART II.

RESUSCITATION.

THE THEORY OF CIRCULATION, RESPIRATION AND RESUSCITATION.

Introduction

In order to convey to the non-professional reader some general idea of the methods adopted in resuscitating the apparently drowned and the principles regulating them, it is desirable to give as briefly as possible a general outline of the human chest, as well as to explain the processes by which breathing and circulation are carried out.

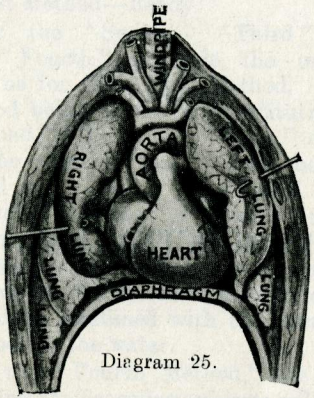

Diagram 25.

The Chest Boundaries and Contents

The THORAX OR CHEST is a cavity, conical in shape, surrounded by the ribs, which pass from the spine behind to the breast bone in front, containing the heart, the large blood vessels, the lungs, and air-pipes leading to them, as well as the gullet or food-pipe. (Diagram 25.)

The Heart, Situation, Construction and Functions

The HEART is a hollow muscular organ about the size of a closed fist, situated between the lungs a little to the left of the centre of the thorax, and is divided into two parts—a right and a left; each side has two chambers, an upper and a lower, the upper being called auricles and the lower ventricles. The right side of the heart receives the blood after it has returned from the body in its impure state, and forces it into the lungs to be purified, whence it returns to the left side to be pumped through the arteries to all parts of the body. The heart is thus the main force in the circulation, its action in propelling the blood through the vessels being by alternate contraction and dilatation. The contraction of the two auricles is simultaneous, and is immediately followed by that of the two

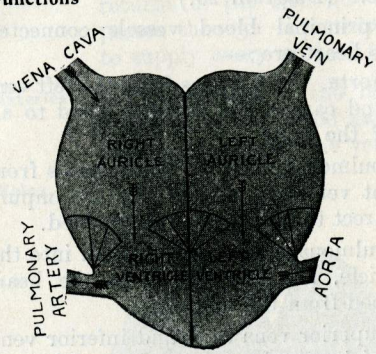

Diagram 26.

ventricles; but as the right and left sides of the heart have no direct connection, the right auricle forces the blood into the right ventricle, and the left auricle into the left ventricle. (Diagram 26.)

Principal Blood Vessels and their Functions

The principal blood vessels connected with the heart are:—

The aorta, which arises from the left ventricle, and carries the purified blood to all parts of the body.

The pulmonary artery, which arises from the right ventricle, and carries the impure blood direct to the lungs to be purified.

The pulmonary veins, which open into the left auricle, and bring back to the heart pure blood from the lungs.

The superior vena cava and inferior vena cava, which open into the right auricle, and return the impure blood to the heart from the body generally.

The Blood: Purification, Circulation

Impure blood, or blood charged with carbonic acid, which it accumulates in its circulation through the body, is a dark red or purple colour, and is no longer capable of nourishing the tissues of the body, being deficient in oxygen. It is therefore returned by the veins through the right side of the heart to the lungs, where, in its passage

around the air-cells, it receives a fresh supply of oxygen and parts with carbonic acid, becoming thus purified, and changing its colour to a bright red. It then again returns to the left side of the heart, and passes through the aorta, or main artery, to supply every part of the body.

Arteries

The arteries of the body are the tubes which carry the blood away from the heart, commencing from the ventricles.

Veins

The veins, on the other hand, are thinner tubes which take the blood back to the heart, entering at the auricles.

Lungs

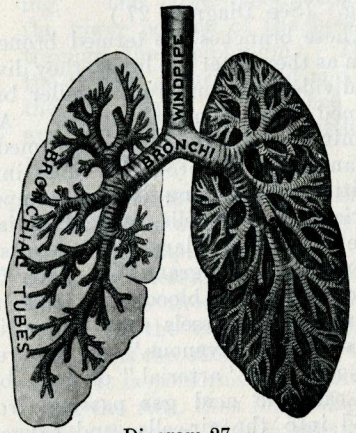

Diagram 27.

The LUNGS are the essential organs of respiration; they are two in number, one on each

side of the chest ; they occupy the whole of the thorax, except that part taken up by the heart, blood vessels, bronchi, and gullet. The only entrance to them is

Trachea through the nose and mouth into the trachea, or windpipe; the latter is a flexible tube, fitted with small rings of cartilage (or gristle) which keep the tube open under all conditions. The trachea passes down the front of the neck from the larynx into the thorax, dividing into two branches, one going to the right and the other to the left lung. (See Diagram 27.)

Bronchi These branches are termed bronchi. As soon as they enter the lungs, they divide and subdivide into numerous smaller branches, termed the bronchial tubes. At their termination are the air-cells, formed by the

Air-cells expansion of the bronchial tubes into little cavities. Each lung is thus composed of myriads of these cells, over which is spread

Capillaries a network of capillary blood vessels closely interwoven. (Diagram 27.) Their function is to purify the blood, and it is in these minute blood vessels that the purification takes place, "venous," or impure being changed into "arterial," or pure, blood by the carbonic acid gas passing from the blood into the air-cells, and oxygen from the air-cells into the blood.

Pleura The lungs, which are highly elastic, are each enveloped in a double membranous bag known as the pleura, the outer bag lining the cavity of the chest and the inner protecting the lung. Below the lungs is a

Diaphragm great arched muscle known as the diaphragm, which separates the trunk into two distinct divisions, the thorax and the abdomen, and is capable of moving down and up so as to enlarge and diminish the thorax or chest during the act of breathing. The large blood vessels supplying the lower portion of the body are carried through the diaphragm. The cavity of the thorax is surrounded and protected by the ribs, which are attached to the spine, and are supplied with muscles capable of raising or depressing them.

Respiration RESPIRATION is the act of breathing. It is divided into two distinct parts—inspiration and expiration—which are brought about by alternate enlargement and diminution of the thorax. Inspiration is produced by the enlargement of the thorax, which has the effect of filling the lungs with air. It is performed by the muscles which raise the ribs, thus increasing the capacity of the thorax. This is assisted by the contraction of the diaphragm, which becomes

flattened instead of curved, thus increasing the depth of the thorax from above downwards; air then rushes in through the trachea and fills the air-cells. Expiration, or the act of emptying the lungs of air, is produced by the elastic resiliency of the lungs and chest-wall; the muscles becoming relaxed allow the ribs, by their elasticity and weight, to fall, and the diaphragm resumes its arched position. But even after expiration the lungs still retain a large amount of air, which can in part be expelled by pressure upon the thorax: on relaxing such pressure air again enters the chest.

Functions of Respiration

The blood, while passing through the capillaries round the air-cells, is brought into close relation with the air in them. The air contains a gas called oxygen, which is taken up by the blood, while the carbonic acid passes from the blood into the air-cells, thus rendering the air in them impure. At the next expiration this is forced out of the lungs, and a supply of pure air is taken in at the next inspiration.

Asphyxia

Death from drowning, or suspended animation as the consequence of electric shock, etc., is the result of asphyxia, or suffocation, due to the stoppage of a

supply of pure air to the lungs. The oxygen gradually diminishes while the quantity of carbonic acid increases, and at length the air in the lungs becomes too impure to effect an exchange with the blood. Then the blood passing into the heart is not properly purified. Consequently venous instead of arterial blood is circulated through all parts of the body. In a short space of time insensibility ensues, the face becomes dark and congested through the veins being gorged with blood, and the heart ultimately ceases to beat.

Methods of Resuscitation

Up to the year 1907 there were three methods of restoring natural respiration taught by the Society. These were the "Silvester," "Howard," and "Marshall Hall": in connection with all of these special attention was necessary in order to keep the tongue drawn forward, because the patient in each case was first placed upon his back. These methods, though they have sometimes proved useful, are attended by certain disadvantages, which become accentuated when the subject is in an asphyxiated condition due to drowning. The position on the back hinders the escape of water, mucus, and froth from the air-passages, throat, and mouth, and

as all the muscles are in a limp or relaxed condition, the tongue has a tendency to fall back and block the air-passages. There may also be water in the air-passages, which, with the mucus usually secreted, becomes churned up into a froth through the air and water passing backwards and forwards, and tends to block the bronchial tubes.

Further, in cases of drowning there is an enormous congestion and swelling of the liver, combined with and caused by a great distension of the heart, especially at the right side. This congested state of the liver renders the Howard method rather dangerous, since forcible pressure upon the lower chest is apt to cause its rupture.

The Schäfer method possesses none of the disadvantages which have been enumerated, as the patient is laid face downward. It is also safe, efficient, less complicated than any other system, and involves a minimum amount of labour on the part of the operator.

The advantages of this method may thus be enumerated:—

1. The ease with which artificial respiration may be performed; hardly any exertion is required.

2. The efficiency with which the exchange of air in the lungs can be produced.
3. The extreme simplicity of the procedure.
4. The impossibility of the air-passages being blocked by the falling back of the tongue.
5. The readiness with which water and mucus are expelled from the air-passages through the mouth and nostrils.
6. It involves no risk of injury to the congested liver or to any other organ.
7. It is very easily remembered, and can be put into operation by one person.

Treatment of Apparently Drowned.

When a person is lifted out of the water in an apparently drowned condition, there must be no loss of time in attempting restoration. The means used to restore life must be carried out with caution, perseverance, and continuous energy, as life has, in many cases, been restored after long hours of unceasing work.

In Cases of Electric Shock

First secure release of the patient from contact, note carefully and quickly the surroundings; then, avoiding contact with any live conductors, and using great caution if high pressures are involved, pull the patient away, if practicable; if not, break the

circuit. To pull the patient away avoid actual contact with the skin; use rubber gloves if at hand, or pull by a loose part of the coat (even this may be dangerous in case of high or extra high pressure) or by any non-conducting dry material available, such as a loop of rope, a coat, broom-handle, rubber hand gloves, or crooked stick. If the patient is holding any portable electrical apparatus, pull out the plug of the connector.

After Release from Contact

Place the body on a dry floor or table, or dry straw, and, if no sign of breathing can be observed, immediately proceed to promote artificial breathing. If there are any burns, these should be treated with an oil dressing and covered from the air.

Avoid Delay

If breathing has ceased, place the patient face downwards on the ground, then, without stopping to remove clothing, commence artificial respiration, *as every instant of delay is serious.*

Rough Usage

Avoid rough usage, especially twisting or bending of limbs, and under no circumstances hold the patient up by the feet.

Medical Aid

In all cases send for medical assistance as soon as possible.

Partial Breathing

In the event of respiration not being entirely suspended, it may not be necessary to imitate breathing; in that case he may be placed upon his side, and natural respiration may be assisted by the application of an irritant substance to the nostrils and tickling the nose. Smelling salts, pepper, or snuff may be used.

To effect artificial respiration, put yourself astride or on one side of the patient's body, in a kneeling position, facing his head. (See Diagram 31.) Placing your hands flat in the small of his back, with the thumbs parallel pointing towards the head, nearly touching and the fingers spread out on each side of the body over the lowest ribs; lean forward, and, keeping the arms straight, steadily allow the weight of your body to fall over upon them, and so produce a firm downward pressure, which must not be violent. Remember that your object is to press downward toward the ground, in order to decrease the size of the chest cavity. (Diagram 30.)

By this means the air (and water, if there be any) is driven out of the patient's lungs. Immediately thereafter swing backward, rapidly releasing the pressure, but without lifting the hands from the patient's body,

your object being to allow the ribs to spring back and thus increase the size of the chest cavity. Repeat this forward and backward movement (pressure and relaxation of pressure) every four or five seconds. In other words, sway your body forward and backward upon your hands twelve to fifteen times a minute, without any marked pause between the movements.

By these means an exchange of air is produced in the lungs similar to that effected by natural respiration: every pressure forces air out of the chest, every relaxation of pressure causes it to pass in.

This procedure must be pursued until natural respiration is resumed. If it is resumed and, as sometimes happens, again tends to fail, the process of artificial respiration must be resorted to as before.

Whilst the operator is carrying out artificial respiration others may, if there be opportunity, busy themselves with applying hot flannels to the limbs and body, and hot bottles to the feet, or promote warmth by friction; but no attempt should be made on the part of the operator to remove the wet clothing or to give any restoratives by the mouth until natural breathing has recommenced.

Promoting Circulation and Warmth

When natural respiration is once established, cease to imitate the movements of breathing. Then you may turn the patient face upward and proceed with the treatment for the promotion of circulation and warmth.

Friction over the surface of the body must be resorted to, using handkerchiefs, flannels, etc.

The friction along the legs, arms, and body should all be towards the heart, and continued after the patient has been wrapped in blankets or some dry clothing. By these means the blood is propelled along the veins towards the heart.

Removal of Patient and further Treatment

As soon as possible after breathing has been established, remove the patient to the nearest house, and further promote warmth by the application of hot flannels to the pit of the stomach, and bottles, or bladders of hot water, heated bricks, etc., to the armpits, between the thighs, and to the soles of the feet. Care must be taken not to burn the patient with these appliances, which should be wrapped in flannel or some other suitable material, and their heat tested with the operator's elbow before application. If there be pain or difficulty in breathing, apply a hot linseed-meal poultice to the chest.

Testing Swallowing When animation has been restored, a teaspoonful of warm water may be given to see if the patient can swallow. If the power of swallowing has returned, and the patient is not dizzy, a very small quantity of wine, warm brandy and water, beef-tea, or coffee may be administered, the patient kept in bed, and a disposition to sleep encouraged.

Watching Patient Watch the patient very carefully for some time to see that breathing does not fail.

Ventilation If the patient has been carried to the house, be careful to let the air circulate freely about the room, and prevent crowding round the patient.