

the bowels and urine, and the secretion of the skin should be kept active by daily baths. Alcohol in all forms should be prohibited, and the food should be restricted to plain, wholesome articles. The use of mineral waters or a residence every year at one of the mineral springs is usually serviceable. If there has been a syphilitic history an occasional course of iodide of potassium is indicated, and whenever the pulse tension is high nitroglycerine may be used.

In cases which come under observation for the first time with dyspnoea, slight lividity, and signs of cardiac insufficiency, venesection is indicated. In some instances, with very high tension, striking relief is afforded by the abstraction of twenty ounces of blood.

III. ANEURISM.

The following forms of aneurism are usually recognized:

(a) The *true*, in which the sac is formed of one or more of the arterial coats. This may be fusiform, cylindrical, or cirroid (in which the dilatation is in an artery and its branches), or it may be circumscribed or sacculated. Aneurisms are usually fusiform, resulting from uniform dilatation of the vessel, or saccular.

(b) The *false* or *dissecting* aneurism, which results from injury or laceration of the internal coat. The blood dissects between the layers; hence the name, dissecting aneurism. This occurs usually in the aorta. It may dissect the entire length of the vessel, and, perforating into the lumen of the vessel, may, as in a case reported by J. E. Graham, persist for years.

(c) *Arterio-venous* aneurism results when a communication is established between an artery and a vein. A sac may intervene, in which case it is called a varicose aneurism; but in many cases the communication is direct and the chief change is in the vein, which is dilated, tortuous, and pulsating, and is termed an aneurismal varix.

Etiology and Pathology.—Aneurisms arise: (a) By the gradual diffuse distention of the arterial coats, which have been weakened by arterio-sclerosis, particularly in its early stages, before compensatory endarteritis develops. The arch of the aorta is often dilated in this way so as to form an irregular aneurism.

(b) In consequence of circumscribed loss of resisting power in the media and adventitia, and due often to laceration of the media. This is the most common cause of sacculated aneurism. The laceration is frequently found in the ascending portion of the arch and occurs early in the process of arterio-sclerosis, before the compensatory thickening has taken place. Occasionally one meets with remarkable specimens illustrating the important part played by this process. The intima may also be torn. In a case of Daland's there was just above the aortic valves

an old transverse tear of the intima, extending almost the entire circumference of the vessel. Sclerosis of the media and adventitia had taken place and the process was evidently of some standing. An inch or more above it was a fresh transverse rent which had produced a dissecting aneurism. These arterio-sclerotic aneurisms, as they are called, are found also in the smaller vessels.

(c) *Embolic Aneurism*.—When an embolus has lodged in a vessel and permanently plugged it, aneurismal dilatation may follow on the proximal side. The embolus itself may, if a calcified fragment from a valve, lacerate the wall, or if infected may produce inflammation and softening. In either case aneurism may result.

(d) *Mycotic Aneurism*.—The importance of this form has been specially considered by Eppinger in his exhaustive monograph. The occurrence of multiple aneurisms in malignant endocarditis has been observed by several writers. Probably the first case in which the mycotic nature was recognized was one which occurred at the Montreal General Hospital and is reported in full in my lectures on malignant endocarditis. In addition to the ulceration of the valves there were four aneurisms of the arch, of which one was large and saccular, and three were not bigger than cherries. An extensive growth of micrococci was present in the larger as well as in the smaller sacs.

A form of parasitic aneurism which occurs with great frequency in the mesenteric arteries of the horse is due to the development of the *strongylus armatus*.

And, lastly, there are cases in which without any definite cause there is a tendency to the development of aneurisms in various parts of the body. A remarkable instance of it in our profession was afforded by the brilliant Thomas King Chambers, who first had an aneurism in the left popliteal artery, eleven years subsequently an aneurism in the right leg which was cured by pressure, and finally aneurism of both carotid arteries.

ANEURISM OF THE THORACIC AORTA.

The causes which favor the development of arterio-sclerosis prevail in aortic aneurism, particularly alcohol, syphilis, and overwork. The greatest danger probably is in strong muscular men with commencing degenerative processes in the arteries (a consequence of syphilis or alcohol or a result of hereditary weakness of the arterial tissues), who during a sudden muscular exertion are liable to lacerate the media, the intima not yet being strengthened by compensatory thickening over a spot of mesarteritis. Aneurisms of the thoracic aorta vary greatly in size and shape. A majority of them are saccular. They may be small and situated just above the aortic ring. Others form large tumors which project externally and occupy a large portion of the upper thorax. Small sacs from the descending portion of the arch may compress the trachea or the bronchi. In the tho-

racic portion the sac may erode the vertebræ or grow into the pleural cavity and compress the lung. In some instances it grows through the ribs and appears in the back.

Symptoms.—The chief influence of an aneurism is manifested in what are known as pressure effects. In the absence of these the aneurisms attain a large size without producing symptoms or seriously interfering with the circulation. Indeed, a useful clinical subdivision as given by Bramwell is into three groups—aneurisms which are entirely latent and give no physical signs; aneurisms which present signs of intrathoracic pressure, but it is difficult or impossible to determine the nature of the lesion producing the pressure; and, lastly, aneurisms which produce distinct tumors with well-marked pressure symptoms and external signs. It is perhaps best to consider aneurisms of the aorta according to the situation of the tumor.

(a) *Aneurisms of the Ascending Portion of the Arch.*—When just above the sinuses of Valsalva they are often small and latent. The first symptom may be rupture, which usually takes place into the pericardium and causes instant death. Above the sinuses, along the convex border of the ascending part, aneurism frequently develops, and may grow to a large size, either passing out into the right pleura or forward, pointing at the second or third interspace, eroding the ribs and sternum, and producing large external tumors. In this situation the sac is liable indeed to compress the superior vena cava, causing engorgement of the vessels of the head and arm, sometimes compressing only the subclavian vein, and causing enlargement and œdema of the right arm. Perforation may take place into the superior vena cava, of which accident Pepper and Griffith have collected twenty-nine cases. Large aneurisms in this situation may cause much dislocation of the heart, pushing it down and to the left, and sometimes compressing the inferior vena cava, and causing swelling of the feet and ascites. The right recurrent laryngeal nerve is often involved in these tumors. Death commonly follows from rupture into the pleura, or into the superior cava; less commonly from rupture externally, sometimes from heart-failure.

(b) *Aneurisms of the Transverse Arch.*—These may grow forward, erode the sternum, and produce large tumors. More commonly they are small and produce no external tumor, but cause marked pressure signs in their growth backward toward the spine, involving the trachea and the œsophagus, producing cough, which is often of a paroxysmal character, and dysphagia. The left recurrent laryngeal is often involved in its course round the arch. A small aneurism from the lower or posterior wall of the arch may compress a bronchus, inducing bronchorrhœa, gradual bronchiectasy, and suppuration in the lung—a process which by no means infrequently causes death in aneurism, and a condition which at the Montreal General Hospital we were in the habit of terming aneurismal phthisis. Occasionally enormous aneurisms develop in this situa-

tion, and grow into both pleuræ, extending between the manubrium and the vertebræ, and may persist for years. The sac may be evident at the sternal notch. The innominate, less commonly the left carotid and subclavian, may be involved in the sac, and the radial or carotid pulse may be absent or retarded. Pressure on the sympathetic may at first cause dilatation and subsequently contraction of the pupil. Sometimes the thoracic duct is compressed.

(c) *Aneurisms of the Descending Portion.*—Pressure signs are not so marked. The pain is often intense, owing to erosion of the vertebræ. Dysphagia may occur. Compression of the lung or compression of certain bronchi may induce bronchiectasy, retention of secretions, and fever. A tumor may appear externally in the region of the scapula, and here attain an enormous size. Occasionally the aneurisms in this region are small and latent, and prove fatal by rupture into the œsophagus. I have reported a case of sudden death, in which the heart and arch of the aorta were normal and the stomach was distended with blood, which could not be accounted for until the œsophagus was slit open, when it was found that a small aneurism in the thoracic aorta, smaller than a walnut, had ruptured into the gullet. The sac may erode the vertebræ and open the spinal canal, producing compression of the cord. Death not infrequently occurs from rupture into the pleura.

Diagnosis and Physical Signs.—*Inspection.*—In many instances this is negative. On either side of the sternum there may be abnormal pulsation, due to dislocation of the heart or to deformity of the thorax. The aneurismal pulsation is usually above the level of the third rib and most commonly to the right of the sternum, either in the first or second interspace. It may be only a diffuse heaving impulse without any external tumor. Often the impulse is noticed only when the chest is looked at obliquely in a favorable light. When the innominate is involved the throbbing may pass into the neck or be apparent at the sternal notch. Posteriorly, when pulsation occurs, it is most commonly found in the left scapular region. An external tumor is present in many cases, projecting either through the upper part of the sternum or to the right, sometimes involving the sternum and costal cartilages on both sides, forming a tumor the size of a cocoa-nut or even larger. The skin is thin, often blood-stained, or it may have ruptured, exposing the laminæ of the sac. The apex beat may be much dislocated, particularly when the sac is large. It is more commonly a dislocation from pressure than from enlargement of the heart itself.

Palpation.—The area and degree of pulsation are best determined by palpation. When the aneurism is deep-seated and not apparent externally, the bimanual method should be used, one hand upon the spine and the other on the sternum. When the sac has perforated the chest wall the impulse is, as a rule, forcible, slow, heaving, and expansile. The resistance may be very great if there are thick laminæ beneath the skin;

more rarely the sac is soft and fluctuating. The hand upon the sac, or on the region in which it is in contact with the chest wall, feels in many cases a diastolic shock, often of great intensity, which forms one of the valuable physical signs of aneurism. A systolic thrill is sometimes present, not so often in saccular aneurisms as in the dilatation of the arch. The pulsation may sometimes be felt in the suprasternal notch.

Percussion.—The small and deep-seated aneurisms are in this respect negative. In the larger tumors, as soon as the sac reaches the chest wall, there is produced an area of abnormal dullness, the position of which depends upon the part of the aorta affected. Aneurisms of the ascending arch grow forward and to the right, producing dullness on one side of the manubrium; those from the transverse arch produce dullness in the middle line, extending toward the left of the sternum, while aneurisms of the descending portion most commonly produce dullness in the left interscapular and scapular regions. The percussion note is flat and gives a feeling of increased resistance.

Auscultation.—Adventitious sounds are not always to be heard. Even in a large sac there may be no murmur. Much depends upon the thickness of the laminae of fibrin. An important sign, particularly if heard over a dull region, is a ringing, accentuated second sound, a phenomenon rarely missed in large aneurisms of the aortic arch. A systolic murmur may be present; sometimes a double murmur, in which case the diastolic *bruit* is usually due to associated aortic insufficiency. The systolic murmur alone is of little moment in the diagnosis of an aneurismal sac. With the single stethoscope the shock of the impulse with the first sound is sometimes very marked.

Among other physical signs of importance are slowing of the pulse in the arteries beyond the aneurism, or in those involved in the sac. There may, for instance, be a marked difference between the right and left radial, both in volume and time. A physical sign of large thoracic aneurism which I have not seen referred to is obliteration of the pulse in the abdominal aorta and its branches. My attention was called to this in a patient who was stated to have aortic insufficiency. There was a well-marked diastolic murmur, but in the femorals and in the aorta I was surprised to find no trace of pulsation, and not the slightest throbbing in the abdominal aorta or in the peripheral arteries of the leg. The circulation was, however, unimpaired in them and there was no dilatation of the veins. Attracted by this, I then made a careful examination of the patient's back, when the circumstance was discovered, which neither the patient himself nor any of his physicians had noticed, that he had a very large area of pulsation in the left scapular region. The sac probably was large enough to act as a reservoir annihilating the ventricular systole, and converting the intermittent into a continuous stream.

The *tracheal tugging*, a valuable sign in deep-seated aneurisms, was described by Surgeon-Major Porter, and has been specially studied by my

colleagues Ross and MacDonnell* at the Montreal General Hospital. To test it the patient should sit up with the head inclined forward, so as completely to relax the neck. The cricoid cartilage is grasped between the index-finger and the thumb and by upward pressure the trachea put upon the stretch. In healthy individuals no sensation is felt, but if an aneurism is attached to it or is adherent in the immediate vicinity, the stretching is accompanied by a well-marked and characteristic tugging. On several occasions I have known this to be a sign of great value in the diagnosis of deep-seated aneurisms. I have never felt it in tumors, or in the extreme dynamic dilatation of aortic insufficiency.

Occasionally a systolic murmur may be heard in the trachea, as pointed out by David Drummond, or even at the patient's mouth, when opened. This is either the sound conveyed from the sac, or is produced by the air as it is driven out of the wind-pipe during the systole.

An important but variable feature in thoracic aneurism is *pain*, which is particularly marked in deep-seated tumors. It is usually paroxysmal, sharp, and lancinating, often very severe when the tumor is eroding the vertebrae, or perforating the chest wall. In the latter case, after perforation the pain may cease. Anginal attacks are not uncommon, particularly in aneurisms at the root of the aorta. Frequently the pain radiates down the left arm or up the neck, sometimes along the upper intercostal nerves. *Cough* results either from the direct pressure on the wind-pipe, or is associated with bronchitis. The expectoration in these instances is abundant, thin, and watery; subsequently it becomes thick and turbid. Paroxysmal cough of a peculiar brazen, ringing character is a characteristic symptom in some cases, particularly when there is pressure on the recurrent laryngeal nerves.

Dyspnœa, which is common in cases of aneurism of the transverse portion, is not necessarily associated with pressure on the recurrent laryngeal nerves, but may be due directly to compression of the trachea or the left bronchus. It may occur with marked stridor. Loss of voice and hoarseness are consequences of pressure on the recurrent laryngeal, usually the left, inducing either a spasm in the muscles of the left vocal cord or paralysis.

Paralysis of an abductor on one side may be present without any symptoms. It is more particularly, as Semon states, when the paralytic contractures supervene that the attention is called to laryngeal symptoms.

Hæmorrhage in thoracic aneurism may come from (a) the soft granulations in the trachea at the point of compression, in which case the sputa are blood-tinged, but large quantities of blood are not lost; (b) from rupture of the sac into the trachea or bronchi; (c) from perforation into the lung or erosion of the lung tissue. The bleeding may be profuse, rapidly proving fatal, and is a common cause of death. It may persist for weeks or

* London Lancet, 1891.

months, in which case it is simply hæmorrhagic weeping through the sac, which is exposed in the trachea. In some instances, even after a very profuse hæmorrhage, the patient recovers and may live for years. A patient with well-marked thoracic aneurism, whom I showed to my class at the University of Pennsylvania four years ago and who had had several brisk hæmorrhages, died recently, having in the mean time enjoyed average health.

Difficulty of swallowing is a comparatively rare symptom, and may be due either to spasm or to direct compression. The sound should never be passed in these cases, as the œsophagus may be almost eroded and a perforation may be made.

Among other signs and symptoms venous compression, which has already been mentioned, may involve one subclavian or the superior vena cava. A curious phenomenon in intrathoracic aneurism is the clubbing of the fingers and incurving of the nails of one hand, of which two examples have been under my care, in both without any special distention or signs of venous engorgement. Tumors of the arch may involve the pulmonary artery, producing compression, or in some instances adhesion of the pulmonary segments and insufficiency of the valve; or the sac may rupture into the artery, an accident which happened in two of my cases, producing instantaneous death.

Pressure on the sympathetic is particularly liable to occur in growths from the ascending portion of the arch. Either the upper dorsal or the lower cervical ganglion is involved. The symptoms are variable. If the nerve is simply irritated there is stimulation of the vaso-dilator fibres and dilatation of the pupil. With this may be associated pallor of the same side of the face. On the other hand, destruction of the cilio-spinal branches causes paralysis of the dilator fibres, in consequence of which the iris contracts, the vessels on the side of the head dilate, causing congestion, and in some instances unilateral sweating. It is much more common to see the pupillary symptoms alone than in combination either with pallor, redness, or sweating.

The clinical picture of aneurism of the aorta is extremely varied. Many cases present characteristic symptoms and no physical signs, while others have well-marked physical signs and no symptoms. As Broadbent remarks, the aneurism of *physical signs* springs from the ascending portion of the aorta; the aneurism of *symptoms* grows from the transverse arch.

Aneurism of the aorta may be confounded with: (a) The violent throbbing impulse of the arch in aortic insufficiency. I have already referred to a case of this kind in which the diagnosis of aneurism was made by several good observers. In a case recently under observation dulness and pulsation existed in the second right interspace with a well-marked systolic and a loud diastolic murmur, which was heard far out in the right mammary region. The question arose whether aneurism was present in

addition to the aortic insufficiency. The post-mortem showed the margin of the right lung retracted and adherent to the pericardium, leaving exposed the aorta, which must have been greatly distended during each systole.

(b) *Simple Dynamic Pulsation*.—No instance of this, which is common in the abdominal aorta, has ever come under my notice. One which came under the care of William Murray and Bramwell presented, without any pain or pressure symptoms, pulsation and dulness over the aorta. The condition gradually disappeared and was thought to be neurotic.

(c) Dislocation of the heart in curvature of the spine may cause great displacement of the aorta, so that it has been known to pulsate forcibly to the right of the sternum.

(d) *Solid Tumors*.—When the tumor projects externally and pulsates the difficulty may be considerable. In tumor the heaving, *expansile* pulsation is absent, and there is not that sense of force and power which is so striking in the throbbing of a perforated aneurism. There is not to be felt as in aortic aneurism the shock of the heart-sounds, particularly the diastolic shock. Auscultatory sounds are less definite, as large aneurisms may occur without murmur; and, on the other hand, murmurs may be heard over tumors. The greatest difficulty is in the deep-seated thoracic tumors, and here the diagnosis may be impossible. I have already referred to the case which was regarded by Skoda as aneurism and by Oppolzer as tumor. The physical signs may be indefinite. The ringing aortic second sound is of great importance and is rarely, if ever, heard over tumor. Tracheal tugging is here a valuable sign. Pressure phenomena are less common in tumor, whereas pain is more frequent. The general appearance of the patient in aneurism is much better than in tumor. There may be signs of enlargement of the glands in the axilla or in the neck. Healthy, strong males who have worked hard and have had syphilis are the most common subjects of aneurism. Occasionally cancer of the œsophagus may simulate aneurism, producing pressure on the left bronchus, and in one instance at the Philadelphia Hospital, with a husky, brazen cough, the symptoms were very suggestive.

(e) *Pulsating Pleurisy*.—In cases of *empyema necessitatis*, if the projecting tumor is in the neighborhood of the heart and pulsates, the condition may readily be mistaken for aneurism. The absence of the heaving, firm distention and of the diastolic shock would, together with the history and the existence of pleural effusion, determine the nature of the case. If necessary, puncture may be made with a fine hypodermic needle. In a majority of the cases of pulsating pleurisy the throbbing is diffuse and widespread, moving the whole side.

Prognosis.—The outlook in thoracic aneurism is always grave. Life may be prolonged for some years, but the patients are in constant jeopardy. Spontaneous cure is not very infrequent in the small sacculated tumors of the ascending and thoracic portions. The cavity becomes filled with lam-