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Syphilitic aortic aneurysm

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SYPHILITIC AORTIC ANEURYSM

BY

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Left Auricular Appendage

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From (S5)
INTRODUCTION

The Greeks had a word for Aneurysm meaning a widening out or a dilatation of an artery or vein, (18).

According to Smith and Gault (73), aneurysm may be defined as a cyst-like mass containing blood and communicating with an artery. Two main types are recognized; true aneurysms in which the sac is made up of one or more of the coats of the vessel wall, and false aneurysms in which the wall is made up by surrounding tissues.

William Boyd (7) says, "A great variety of aneurysms have been quite unnecessarily described". He classifies aneurysms into true and false as above. A fusiform aneurysm is one which is a more or less uniform dilatation of the entire lumen of the vessel throughout an appreciable part of its length. A saccular aneurysm consists of a pouching of the vessel at one point. It may communicate with the vessel by a narrow or wide opening. The arteriovenous aneurysm is an abnormal communication between an artery and vein. Of these there are two types: traumatic and congenital fistulae. The latter is often called cirsoid aneurysm. It is a direct shunt between an artery and a vein without the interposition of the usual capillaries and as a result the vein becomes dilated. Any artery may be the site of such a dilatation, but in practice we may distinguish aneurysms of the aorta and its
main branches, aneurysms of the arteries of the abdominal viscera, the limbs, and of the brain. There are several types of aortic aneurysm of which we shall discuss the syphilitic aortic aneurysm in this thesis. There are also the rheumatic (usually in children), the rare traumatic form and the dissecting aneurysm.

Shennan (70), who reviewed the literature compiling almost 293 cases of dissecting aneurysms up to 1934, states that syphilitic etiology is usually regarded as one of the outstanding differences between syphilitic and dissecting aneurysms. He gives the definition; "A dissecting aneurysm is the lesion produced by penetration of the circulating blood into the substance of the wall of the vessel with subsequent extension of the effused blood for a varying distance between its layers". The etiology is generally believed to be a degeneration of the media, idiopathic and/or toxic.

Boyd (7) in 1924 reported on 4000 cases of syphilitic aneurysms gathered from the literature. He states that aneurysm is not rare; the mortality being 0.1% to 0.5% of deaths in American cities.

Mills and Horton (49) in 1938 reported on a large series of aneurysms. Of these 56.9% were thoracic and of these 85% were syphilitic, the remaining 15% being of the dissecting and other types. Most other statis-
tical studies give slightly higher figures than this, but it is a good average of the present trend in incidence of syphilitic aortic aneurysm.

The sex distribution is interesting in that women rarely have aneurysms. The ratio being on the average 1 to 10 in favor of the males (25). Other authors (52) claim that syphilitic aortic aneurysm is twice as common in males than in females. Positive Wasserman reactions can be obtained in 98% of patients with aneurysm. Of 6,420 patients, 10% had cardiovascular syphilis; 1.2% of whom had aortic aneurysm. 80% of all patients had never received adequate treatment for early syphilis.
In the Orient a very ancient knowledge of aneurysm is claimed. According to Edmund Owen (cit. (26)), the Hindu surgeon Susrut about 600 B.C. was acquainted with aneurysm, but did not treat it. According to Wang, History of Chinese Medicine (81) Aneurysm was known to Ts'ang Kung, 180 B.C., who, in writing 25 case histories in the Shih Chi Ts'ang Kung Chuan, describes such a case. Several syphiloids are described in the ancient literature of India and China (26).

One of the earliest descriptions of rupture of aortic and of abdominal aorta is contained in the work of Aretaeus the Cappadocian, first century A.D. (Cit.: (26)). In the light of the modern knowledge, it is clear that Aretaeus in his diseases of the vena cava has furnished a description of thoracic and abdominal aneurysm of ancient times with unusual clarity.

Galen (18) appears to be the first author in antiquity from whom we learn of aneurysm, and his knowledge was limited to pulsating enlargements occurring underneath the skin. His familiarity chiefly centered about vessels which had been injured and about which a pulsating haematoma had developed which he found could be compressed under the hand, causing the disappearance of the mass. By experiment he found that it was unwise to attempt in-
cision into these tumors without preliminary ligation, for he states that the blood is spouted out with much violence and can scarcely be arrested. Furthermore, he observed that when an aneurysm is compressed within the fingers, a peculiar thrill is felt within it, caused by the rush of blood. Galen also encountered vascular dilatations in the absence of injury which he concluded to be of the same character as traumatic aneurysm. It is probable that he confused venous dilatations and arterial aneurysms in his descriptions.

Antyllus, the surgeon (cit. (26)), is supposed to be the first to treat intelligently of aneurysm. He speaks of the dilated and ruptured aneurysms and describes in detail the operation of ligation which has taken his name. This, however, deals with external aneurysms.

Aetius (1), second century, is the next of the Greeks who came nearer to describing an internal aneurysm. He says the disease may occur in any part of the body, but is most frequently met with in the throat where it gives rise to a tumor that goes by the name of bronchocele.

The Latin surgeons of the middle ages added nothing to what had already been transmitted from the Greeks. Henry de Mondeville (cit. (26)) gives some interesting comments, particularly on the name. He calls attention to the fact that in Avicenna's Canon it is called by
"mater sanguinis", a sea or sac of blood; other names being "burismus" and "operisema", probably through the errors of copyists.

Fernelius (15) in 1542 recognized the difference in the character of the lesion arising from injury, and occurring spontaneously. He pointed out that in those cases where an injury had broken a vessel and permitted the escape of blood, the tumorous enlargement was partially composed of coagulum within a cavity and fluid in its center. Furthermore, Fernelius recognized not only the development of aneurysm in the external and superficial vessels but also in the internal arteries, especially in the chest or about the spleen and mesentery where a violent throbbing may frequently be observed. Fernelius was the first to bring to our attention the presence of aneurysms in the deep tissues, and, although he did not describe the nature of the aneurysmal dilatation within the thorax, we presume that he was referring to an aneurysm of the aorta.

The recognition of internal aneurysm during life was first made by Vesalius (cit. (39)) who described its presence in the thoracic and abdominal aorta. Vesalius in 1557 was able to demonstrate the lesion clinically and verify the diagnosis by dissection after death. His findings were very convincing, and he seems to have had
the opportunity of studying completely a number of cases.

It was, however, Pare (60) in 1561 who appreciated aneurysm, its severity and mode of origin. To him we owe the first clear description of aneurysm in its different forms. He applied the term to all types of dilatation of the arteries, whether occasioned by wound or of unknown cause. Pare also recognized the clinical manifestation of a bruit, which may be perceived either by the ear or by touch when slightly compressing the tumor. He also observed that thrombosis was very apt to occur within the cavity of the dilated vessel. Pare was very skeptical respecting the treatment of the larger aneurysm; for the smaller ones he advised ligation. Aneurysms which occur in internal parts be believed were incurable. Pare's belief that aneurysm was so common in the neck of pregnant women was based on a mistaken diagnosis, in which the vascular enlargement of the thyroid with its evident pulsation was the misleading feature.

It would appear that in the days contemporary with Pare, some of the aneurysms described were venous varices. These observations were for the most part made clinically, some of them being dealt with by surgical means. A clear differentiation between pathological process arising upon the arterial and venous channels of the extremities was not made. This confusion is
suggested by the frequency with which the aneurysms were observed upon the extremities.

Even after Paré's description of aneurysm, there appeared to be some confusion as to the actual nature of the tumor. Sennertus (cit. (39) in 1628 again drew attention to the differentiation between subcutaneous and interstitial blood effusions and aneurysm. He attempted an explanation for the mode of origin of aneurysm and indicated an appreciation of the structure of arteries.

We are hardly correct in attempting to associate the aneurysm of these men with any specific disease, when the fact is borne in upon that syphilis was an unknown disease at that time (39). It is probable, and the reports of Galen (18) bear out, that the aneurysms recorded in his time were traumatic in origin or were associated with forms of arterial disease other than syphilis. The information regarding aneurysms prior to the close of the fifteenth century is very meager. That aneurysm was known and occasionally encountered there is no doubt, but its frequency appears to have been small and its importance was insufficient to lead to much comment. The aneurysms of the first fifteen centuries of the Christian era appear to have been mainly those attached to the peripheral vessels, and no comment is made respecting those important tumorous masses of the thorax which are of
greatest interest today.

Almost suddenly with the beginning of the sixteenth century, aneurysms received new prominence. In part we may ascribe the greater interest to the more acute observations of the new medicine beginning with these times. However, the history of aneurysm, because of the intimate relation between its important types and syphilis, follows closely the spread of lues through all countries. It is impossible to consider aneurysm as it is known to us today without an understanding of the part played by syphilis through all ages.

For brief consideration the history of syphilis may be roughly divided into four periods (37): the first extends from 1493, when syphilis was first noted in Europe, to 1767, the year of John Hunter's classical experiment which he thought proved that syphilis and gonorrhea were different manifestations of the same disease. The second or Hunterian period extends from 1767 to about 1838, when the separate identity of gonorrhea and syphilis was finally established. The third period includes the years following the establishment of the French school of syphilology by Ricord, Rolle, and Clerc to the discovery of the treponeme in 1905, of the Wassermann reaction in 1906, and of arsphenamine in 1907. The fourth period or the modern era of syphilis extends from the years 1905-07.
to the present time.

The early part of the first of these four periods was one of extreme confusion. Syphilis was a new disease, appalling in the rapidity with which it spread and the severity of its manifestations. Medicine, dominated to a great measure by astrology, mysticism, and superstitions, was hopelessly inadequate in meeting the challenge of this unexpected plague. Consequently, it was blamed on "Divine Wrath", the malposition of the stars, or dominance of the wrong body humors (37). Fortunately, this confusion did not last long. The introduction of syphilis into Europe occurred almost simultaneously with an awakening of interest in science and the development of a new approach to the problems of medicine. The leaders in this revival were attracted by the new disease, and shortly after its appearance it was the subject of intense study by numerous able observers. In a comparatively brief time they began to dispel the superstitions with which syphilis was regarded by presenting an intelligent explanation of many of its manifestations. The sequence of the early course of the infection and the frequency with which it was contracted by sexual contact were quickly understood. Extragenital infections were also recognized and carefully studied.

Shortly after the return of Columbus in 1493 to Spain,
Diez de Isla (cit. (39)), a physician of Andalusia stated that he had treated some of the ship's company for a new transmissible disease which had appeared among the sailors a year previously and while still in America. For some years following, this physician claimed to have had an opportunity of seeing the spread of the disease and of studying many cases in Lisbon. He collected his observations in a published work which appeared between 1510 and 1520. In this treatise he referred to the malady as the "disease of the Island of Espanola", and commented upon the fact that the disease was unknown in Europe before the year 1493. He found that the members of the ship's crew observed the presence of the disease in the natives of the newly discovered land. In his royal report to Charles V, he stated that the disease was contracted from Indian women by the Spaniards with Columbus and was brought by them to Spain.

One of the leading antagonists at present to this theory of the origin of syphilis is Holcomb (cit. (37)) who concludes as a result of a thorough and scholarly study of the pertinent medical and lay writings of the fifteenth and sixteenth centuries, and particularly those which appeared between the years 1491 and 1554, that syphilis was prevalent in Europe prior to the return of Columbus. Pussey (63) on the other hand, after an equally careful study of the same sources, believes they lend
support to his contention that syphilis originated in America or was brought from America to Europe. Data gained from the examination of the bones, particularly those of the skull and extremities, of individuals who died in Europe, India, and Egypt before and after 1493 and from the bones unearthed in the mounds and graves of American Indians, is much less controversial. According to Pussey (63), Virchow, who was almost as noted an anthropologist as he was a pathologist, stated as late as 1866 that he had found no evidence of syphilis in the bones of Europeans who had died prior to 1493. After that date, however, bones unquestionably syphilitic were frequently encountered.

As early as 1498 Villalobos (76) suggested that the lesions of secondary syphilis were infectious, an observation that was overlooked for over 300 years.

Early in the sixteenth century both Fernelius and Pare associated some aneurysms with syphilis (39). However, the Italian physicians at the end of the seventeenth and beginning the eighteenth centuries were really the first to lay great emphasis on the syphilitic origin of aneurysm (57).

The first description of the gross pathology of syphilitic aortic disease was noted by Morgagni in 1725 (cit. (36)) and is as follows: "In some places whitish marks
of a future ossification occurred; in others, some small foramina, as it were, had begun to be formed; and in still other places were paralleled furrows, drawn longitudinally; and in this manner was the surface of the artery unequal here and there.

The discussion on aneurysm by Lancisi in 1728 (42), the distinguished Roman physician, is much the best of those of older writers. He approached the subject systematically, dealing with its distribution, pathological anatomy, classification, and etiology. He appears to be the first one to have analysed carefully the manner of development and the part played by the contained blood of arteries acting upon diseased vascular walls. During his time the more frequent occurrence of aneurysm within the thorax led him to formulate principles which are applicable to the problem of aneurysm at the present time. He realized that there were many factors brought into play for the development of aneurysm. Lancisi states that persons doing hard labor as porters, ball players, etc. are more likely to have aneurysms due to greater force of the blood. He also says that increased impulse of the blood, which gives rise to a "spurious aneurysm" can rarely occasion a true one unless at the same time the coats of the artery are generally or partially weakened, so that an eroding liquid may increase the power
of this cause. He applied the terms "true and false", but not in the modern sense, and described skeletal erosion by an aneurysmal sac as an acrid fluid, distilling from the aneurysmal cyst or sac, which may penetrate as far as the bones or ligaments, which it may gradually corrode. He also discussed mercury as a cause of aneurysms. Further he believed that "Mercurial fluid" in the vessels cause distention of them much as it caused swelling of the salivary glands. Lancisi knew that aneurysm interfered with blood flow through the arteries which may cause gangrene of the extremities. He laid great stress on mental disturbances causing aneurysm, calling them hypochondriacal and hysterical types. He recognized that the radial pulse in aortic and great vessel aneurysms may be small and irregular.

A. Monro (cit. (39)) in discussing the formation of aneurysm, 1733, depicted the manner in which traumatic lesions were associated with their occurrence. In his researches he was able to find only two or three specimens in which the wall of the aneurysmal sac consisted of the annular muscular fibres, and this he believed was the only criterion whereby true aneurysm could be distinguished.

At about this time aneurysms appear to have been fairly common in England, for William Hunter (33) in 1757
reported his observations upon a number of them. He recognized three types of aneurysm: true by dilatation, false by rupture, and mixed; that is, partly by dilatation and partly by rupture. He gave as his opinion that aneurysm of the aorta was incurable. He recognized clearly the association of syphilis with aneurysm; but he did not think that this was the only cause of the aortic disease.

William Hunter (33) appears to have been the first to recognize clearly the development of the arteriovenous aneurysm produced through blood-letting. During the operation of venous puncture, the knife is by accident driven through the vein walls into the underlying artery. This, he found, led to the permanent establishment of a communication between the artery and vein.

A very interesting series of aneurysms was observed by Donald Monro (50) in 1760. Some of the lesions he recognized as arising in association with injury, while the internal thoracic type he believed of spontaneous origin. Monro, by much careful dissection, was able to show that true aneurysm may exist with the dilatation of all the coats of the arteries, or that the aneurysm may possess in its covering only portions of each layer. Monro could offer no common cause for the majority of true aneurysms. Strainings of the body, an increased
momentum of the blood, and a stop put to its free circulation through some of the large vessels, has been alleged to give rise to several. "Sometimes a scorbutic or venereal taint, or some other acrimony in the blood" has been accused.

Monro (50) remarked upon the frequency of aneurysms of the aorta near the heart, being almost equal to, if not greater than, those in all other parts of the body together. It is still true today that aneurysms of sufficient importance to attract attention are for the most part located within the chest; nor has the type of aneurysm described by Monro changed in any manner. The mode of death was possibly more frequent by rupture in his time than in ours.

Advancement in the knowledge of syphilis continued with steady progress. By the beginning of the eighteenth century, or by the end of the first of the four periods into which Kemp (37) has divided the history of syphilis, syphilitic lesions of the bone, eye, skin, viscera, the aorta, the cerebral vessels, and the upper respiratory tract had been recognized and roughly classified.

The teachings of John Hunter (32) so completely dominated the second period of the history of syphilis that it is aptly called the Hunterian period. It is unfortunate that Hunter, one of the great men of medicine of
all time, is frequently remembered as the man who retarded progress in the knowledge of syphilis for at least fifty years. The controversy raised by Hunter concerned the dual etiology of syphilis and gonorrhea. In 1560 Paracelsus (59) called syphilis "French gonorrhea", apparently because he thought gonorrhea and syphilis were the same disease of different manifestations of the same disease. This conception was accepted without serious question for the ensuing 150 years (37). However, by the end of the eighteenth century there was an accumulation of evidence which indicated that syphilis and gonorrhea were entirely different diseases which had in common only the frequency with which they were both contracted by sexual contact. Hunter (cit. (37)) refuted this growing appreciation of the duality of the two infections by affirming they had a common etiology, and that the character of the surface upon which the virus was implanted determined whether gonorrhea or syphilis follows: that is, if infection occurred on a secreting surface such as the urethra, gonorrhea resulted; if, however, infection occurred on a nonsecreting surface such as the skin, syphilis resulted. In an effort to prove his contention, Hunter inoculated himself on the penis with gonorrheal pus and developed syphilis and gonorrhea both. Unfortunately the individual from whom the inoculum was taken
had both gonorrhea and an unrecognized chancre.

Comments made by Baillie (4) in 1789 upon aneurysms are very clear, and although he did not associate its development with lues, it is unquestionable that the specimens which he described were of this kind. He said the most frequent situation of aneurysms within the cavity of the thorax is at the arch of the aorta. He claimed that the reason why aneurysms take place more frequently in the arch of the aorta, than in any other part of the arterial system, is its curvature, which exposes it to the full impetu of the blood propelled by the strength of the left ventricle. Baille recognized that aneurysm in the arch of the aorta, as well as in every other part of the arterial system, happen much more rarely in women than in men.

Lobstein (cit. (39)) in 1833, who is the author of the term "arteriosclerosis", believed that true aneurysm was not caused by the lateral pressure of the blood, but followed in the wake of arteriosclerosis. According to Scarpa in 1805 (67) all aneurysms without distinction arise through rupture of the arterial coats following upon their degeneration, no matter of what type, and that the sac is formed by the dilatation of the external coat of the artery. In other words, he believed that the aneurysm was not contained within the true arterial wall, but only
within a small portion of its exterior. Lobstein disagreed with this, inasmuch as the theory was not applicable to diffuse or fusiform aneurysms. Dubois and Dupuytren (cit. (39)) found that the internal coat of the artery was always extended over the inner surface of the aneurysmal sac. Laennec (cit. (39)) in the early part of the nineteenth century, recognized the great damage which was done to the middle coat of the artery and observed the disappearance of the muscular tissue in its structure. His means, however, to obtain a thorough understanding of the extensive destruction which takes place in syphilitic aortitis were limited.

It was the medical officers of the British army who forced the recognition of the part played by the disease syphilis in aneurysms upon the attention of the profession (57). Unfortunately, many of the communications were buried in Annual Reports which never had the proper recognition.

A very important communication was that by Inspector-General Lawson (cit. (57)) in which he pointed out the great frequency of aneurysm in the British army, and its increase at Aldershot from the ration of 0.25 in 1860 to 1.68 in 1868. Olser says that he believes Lawson was one of the first to recognize clearly the independence of aneurysm of the ordinary atheromatous changes in the
arteries.

Klotz, (39) also gives medical officers in the British army the important credit in recognizing the intimacy between syphilis and aneurysm. "These men," he says, "Crisp in 1847, Lewer in 1862, Aiken in 1866, Lawson in 1868, Myers in 1870, and Welch in 1876, presented irrefutable evidence by the demonstration at autopsy of the common presence of aortic disease in known syphilitics and by showing the stages of development of the aneurysmal pouches in these luetic aortas." Syphilis amongst soldiers had always been accepted as high in incidence but it had never been so forcefully shown that the infected groups had a definitely high percentage of internal aneurysm.

The work of Crisp (12) was of particular importance, as it was the first monograph in the English language dealing with the subject in a general manner and based upon a large number of cases. Even at this time, 1847, Crisp was able to collect 551 cases of spontaneous aneurysms from the British medical journals between the years of 1785 and 1847. The cases were carefully analysed as to the distribution upon the arteries, the age periods of 1785 and 1847. The cases were carefully analysed as to the distribution upon the arteries, the age periods of occurrence, sex, and history of syphilis. Crisp also
believed that mercurial poisoning, passions of the mind, blows, and lifting heavy burdens were origins of aneurysms. He wrote letters to medical men the world over determining the incidence of aneurysms and found that in India and in the West Indies aneurysms of the natives were practically unknown. He offered no explanation for this phenomena.

Welch (79) in 1875 presented data attempting to prove that syphilis was the cause of aortic aneurysm in 66% of 52 cases of aneurysm found at autopsy in soldiers. He described his gross findings, and stated, "this disease of the aortic coats may retrogress-- but if extensive or severe, as a rule it is followed by one of three fatal phases; formation of aneurysms, implication of aortic valve, or hypertrophy with or without dilatation of one or more of the heart's cavities". The paper was very unfavorably received and its discussants openly expressed their unbelief.

The importance of syphilis was thus well established by the latter part of the nineteenth century, although in some quarters the part played by arteriosclerosis, high blood pressure, anomalies of structure, and other infections, was still maintained to be equal to its influence in the origin of aneurysms (39). The microscopic differentiation of the syphilitic lesions from
other forms of disease had not yet been made and the causation of the infection was not yet discovered. However, the therapeutic test as shown by the French authors, Fournier, Vallin, Verdie, and others, as well as reports by Muelhaus and Schmidt in Germany, gave further support to the syphilitic nature of the process (cit. 39)).

There were a good many exceptions, and the view has gradually gained acceptance; and in 1894 Goodhart (cit. (57)) made the strong statement that "It is sufficiently near the truth to say that women never have aneurysm except they have had syphilis". Virchow and others in Germany, Lancereaux and others in France, were strong supporters of the syphilitic view. The Dublin physicians, whose contributions to the subject of aneurysms have been so important, described many cases associated with syphilis. Sir Samuel Wilks (80) was the first in Britain to recognize the importance of syphilis in arterial disease, and in his well known paper he described the characteristic syphilitic arteritis of the cerebral vessels. In 1868 Sir Clifford Allbutt (cit. (57)) studied the histological changes in the arteries in a case of cerebral syphilis.

An important work which is frequently overlooked is that of Barkow (cit. (39)) who published three unwieldy volumes in 1869, 1871, and 1872. Although this author did not discuss the importance of syphilis as observed
by him, his drawings show syphilitic lesions of the aortic wall in many cases where distortions and dilatations occupied their course.

The discoveries which opened the fourth period of the history of syphilis occurred with startling rapidity. In 1905 Fritz Schaudinn (cit. (37)) discovered the organism of syphilis, the *treponema pallium*; in 1906-07 Wassermann, Neisser, and Bruch, And Detre (78) announced the discovery of a serologic (complement fixation) test for syphilis; and finally in 1907 Ehrlich (13) discovered arsphenamine, and two years later released it for general use for the treatment of syphilis.

Another important event in the history of syphilotherapy was the introduction of bismuth by Sazerac and Levaditi in 1921 (cit. (39)). Carrying on the promising work of Sauton and Robert, interrupted in 1914 by the war, Levaditi and his co-workers made extensive experimental studies of many bismuth preparations. Their report of satisfactory clinical results following the intramuscular administrations of sodium and potassium tartrobismuthate was promptly confirmed.
Before the discovery of the circulation of the blood in 1628 an adequate understanding of the pathogeny of aneurysm was impossible (11). The real story of syphilitic aortitis begins in 1876 when Francis H. Welch (cit. (40)) a pathologist at Netly, England described for the first time, its essential macroscopic and microscopic features, and pointed out quite convincingly its relationship to syphilis.

For some years before this it had been held that syphilis played an important role in the production of aneurysm. Ambrose Pare in the sixteenth century was the first to suggest this. Lancisi in 1728 spoke of a venereal aneurysm, and Morgagni in 1761 gave ample evidence of the importance of syphilis as a cause of aneurysms.

Welch, however, was the first to demonstrate the actual pathology and to lay the foundation for a real understanding of the disease as it affects the aorta. His publication was strongly contested, then forgotten. Ten years later Dohle (cit. (40)) published a comprehensive report on the disease which aroused interest in the disease again and confirmed Welch's work.

The demonstration of the same process in a high percentage of syphilitic fetus and the finding of the treponema pallidium in sections of syphilitic aortas by
Rueter and Schmorl in 1907 (cit. (40)), the introduction of the Wassermann reaction (78) with its high percent of positive results in these cases, were further mile stones in establishing the knowledge of syphilitic aneurysm and aortitis on a firm basis.

If we think of an artery as having all the coats of an automobile tire, we are able to understand the mechanism by which syphilis works such frightful damage to the arterial system (11). Now the rubber on the outside casing may wear right into the fabric (media) and we will consider this outside rubber as the adventitia. As long as the fabric of the casing is intact the air inside the inner tube (intima) will be in no danger of bulging through the other coats causing a blowout. Let a lesion (cut) go through the fabric and there is trouble at once from the elastic pressure within. Syphilis cuts the musculo-elastic tissue of the media and thereby makes possible the bulging of the other coats through the rent.

How? In the larger arteries, that is the thoracic and abdominal aortas, the vessel wall is nourished by means of the vasae vasorum. In the smaller arteries with their thin coats, nourishment of the arterial tissues takes place both from within and without being as it were laved in plasma by means of the lymphatics.

In arterial syphilis involving the aorta let us say,
the changes begin in the adventitia and pass back into the media. In a fully developed local lesion we find the media infiltrated with round cells. Lymphocytes and plasma cells form along the area nourished by the vasae vaso rum. So that, looked at from the internal side, we see these elevated patches due to the accumulation of these cells and their organization into fibrous tissue. This fibrous tissue takes the place of nonstriated muscle and elastic tissue of the media. Instead of expansive tissue destroyed by the miliary gumma we now have an area of artery with the "fabric" replaced by scar. It is through this area of mesarteritis that the aneurysm bulges.

When these areas are close together the artery may bulge as a whole. If the damage is not so great we may get little saccules which are the beginning of sacculated aneurysms. Syphilis is the only disease which gives this widespread change in the media (11).

The most important change is the result of endarteritis and periarteritis of the smaller arteries, in association with infiltration of lymphocytes and plasma cells around them, these changes being brought about by the presence of treponemes in the adventitia. This is the case wherever syphilitic disease occurs and when the aorta is attacked the lesions are essentially in connection
with the vasae vasorum appearing first in the adventitiae and then invading the media. Owing to the important results in the latter, the lesion is sometimes spoken of as syphilitic mesoarteritis. The initial lesion is the formation of a plaque or area of thickening in the intima, of greyish-white color and somewhat translucent appearance. Such plaques are often of considerable thickness and show little tendency to degenerate. Later they extend and fuse together forming areas of somewhat wavy or slightly wrinkled surface, while the intima in the parts between may be healthy in appearance. At places, absorption and contraction of the tissue may occur with formation of cicatricial tissue which occasionally has a somewhat stellate form.

Localized depressions which are potentially the commencement of aneurysms, may sometimes be seen. At a later period of life, the yellow patches of atheroma may be associated with syphilitic lesions. The aortic arch is by far the commonest site of syphilitic lesions and they are sometimes restricted to it. The part of the arch immediately above the aortic valve is usually involved first and disease may have two serious results. It may lead to narrowing of the orifices of the coronary arteries or it may spread to the aortic cusps, producing thickening of them and resulting in incompetence of the valve. In this way syphilis is often the cause
of important cardiac disease and disturbance. The lesions occur, too, at a lower level, but it is not uncommon to find that they cease at the point where the aorta passes through the diaphragm. Sometimes, on cutting through the aorta, one may find evidence of the extension of comparatively soft, or even gummatous tissue from the outside, but as a rule the characteristic changes in the adventitia can be detected only on microscopic examination.

The earliest histological change, then, is to be found as a cellular infiltration around the small vessels in the adventitia, attended by periarteritis and endarteritis. The infiltration then extends along the vessels into the substance of the media, and at places widens out into irregular cellular areas, in which there is also a new formation of thin-walled vessels.

Syphilitic aortitis, the precursor of aneurysms, with rare exception begins in the supra sinus aortae just above the aortic valve. It may remain localized as an uncomplicated aortitis; or more often, it extends downward to involve the commissures and valves in rather a typical manner. The ascending aorta and aortic arch are well supplied with lymphatics and the invasion of the aorta occurs through these lymphatics accompanying the vasa vasorum.

Syphilitic aortitis is first to be looked for in the
ascending aorta (39). Next, most commonly we find that the lesion lies in the arch and, following this in lesser frequency, within the thoracic aorta. In almost all instances where the arch or the thoracic aorta, or both, show a syphilitic process, we find that earliest damage has occurred close to the heart. It is remarkable to note that in the majority of cases of syphilitic aortitis within the thorax, the lesion seldom goes beyond the diaphragm. It would appear that the virus does not find ready access to the lymphatic channels lying beyond this structure. It is likewise interesting to observe that a syphilitic aortitis involving the arch frequently leads to an extensive nodular overgrowth about the mouths of the vessels entering the neck and yet fails to enter these vessels themselves. Klotz (39) states he has repeatedly seen healthy carotids and innominate artery attached to a seriously diseased aorta.

The abdominal aorta is but seldom involved in a syphilitic process. When it does occur its most common site of development is about the coeliac axis which is the point where the abdominal lymphatics centralized about the aortic wall and encircle it in a rich network of lymph channels (39).

The ratio of aneurysms in the various portions of the aorta is approximately 10 ascending, 7 arch, 3 descending
and l thoracic in over 3000 cases reviewed by Boyd (7).

Aneurysms of the ascending aorta has been divided into two types: of the intrapericardial portion (aneurysm of symptoms) and of the extra pericardial portion (aneurysm of physical signs) (55). In reference to the first type, it should be noted that they are usually found at the sinus of valsalva upon the right anterior surface of the aorta. These aneurysms of symptoms are prone to rupture before manifesting marked physical signs unless aortic regurgitation complicates. The symptoms are those of syphilitic aortitis. Since the second type has large sacs which displace and compress neighboring structures, they have been denominated "the aneurysm of physical signs".

Aneurysm of the arch is another aneurysm of symptoms. They are usually found upon the posterior or posterior inferior part of the vessel and tend to involve the orifices of the innominate artery. The usual growth is backward so that the various vital structures in the vicinity of the dorsal surface suffer early. Anterior growth causing midline tumor is known but is not as common.

Aneurysm of the upper descending aorta is an "aneurysm of latency" (7). In spite of the many possibilities for the production of respiratory, esophageal, or vertebral
symptoms, this type is especially liable to be overlooked. The frequency of failure to discover aneurysms of this nature is due to the fact that the findings are frequently to be discovered upon the back; the examination of which is usually minimized. Anterior growth in the left subclavicular space is known. It should be emphasized that the location of the sac in the various forms is not pathognomonic but only suggestive.

Aneurysm of the lower descending aorta is another aneurysm of latency differing from the above in merely the greater liability to pleural or lung rupture and a rarity to esophageal rupture.

The luetic process produces a weakening of a diffuse segment of the aortic walls, resulting in aneurysmal dilatations of two types: fusiform, which is produced by a diffuse luetic infiltration with thinning of the walls and intact arterial layers, (it is infrequent in occurrence and runs a benign course without pressure phenomena) and, saccular which is a luetic infiltration with thinning of a discrete portion of the aorta (5%). This type may remain benign until rupture of the aortic wall takes place. Then, if situated near an important viscus such as the left bronchus, early pressure symptoms occur. Later there is more or less extension of the aneurysmal sac; the outer layer of which may be adventitial or peri-
adventitial tissue. There are then produced adhesions to, and displacement of, important structures, fistulous openings into hollow viscera, and sudden large hemorrhages.

In the ascending aorta and arch, saccular aneurysms occur more frequently at the convex and posterior surfaces, because these parts are subject to greater hydrostatic strain from the moving column of blood.

Dynamic pressure and displacement of structures, adhesions or fistulae to neighboring organs, depend on local anatomical relations and the extent of the aneurysmal sac. Once formed, the aneurysmal sac expands progressively usually outward from the artery following the lines of least resistance until it meets with some obstruction (25). The higher the blood pressure the more rapid the dilatation. When the wall of the sac presses upon neighboring tissues, it begins to erode them. The pressure acts in the following way: It cuts off blood supply to the neighborhood because the pressure within (aortic) is greater than smaller vessels. Necrosis takes place from the compression and the products of necrosis are absorbed by the cells in the tissues of the very vascular wall of the aneurysm as fast as they are stained. Bone tissue too is absorbed by action of the osteoclasts, and the wall of the sac thus advances through the chest wall very much as a tumor might do. It goes through bones, muscles,
nerves, other vessels, etc. always being forced in a straight line by arterial pressure in aorta. Hence aneurysm usually points in the direction given them by the impact of the blood stream: those of the descending aorta pointing to the right; those of the arch pointing backward and to the left. However, resistance of the surrounding tissues and especially local thinning of the aneurysm wall may cause its course to be deflected somewhat from these typical directions.

Of all the aneurysms of the aorta producing spinal cord compression reported in the literature as far as can be determined were of syphilitic origin (71). Only one in 100 to 200 erode the spinal cord but about one half involve the vertebrae. The compression and resultant clinical symptoms may be due to any one of three occurrences: The aneurysm may produce direct pressure on the cord; an epidural hemorrhage due to rupture of the aneurysmal sac may result or the weakened bone structure may collapse and pinch off the cord. There is no case on record where the dura has been penetrated. It may however, be involved in adhesions to the aneurysmal sac. The microorganism of syphilis, like that of tuberculosis possesses the remarkable ability to survive over long periods of years in the human body without producing demonstrable physical signs or clearly defined subjective symptoms (54).
From the pathological standpoint, it was thought interesting to note the time interval between the infection and the production of the first symptoms of aneurysm (7). This was noted in 200 cases and it was found that the average time was twenty years, which corresponds in general to the upper limit of the maximum time interval for syphilitic aortitis. The minimum time was one year (syphilitic aortitis has been reported in six months). The upper limit was fifty-six years after infection. In one case beginning aneurysm was found at autopsy when the chancre was still on the penis. The importance of these figures outside of showing the usual time interval is to emphasize that the syphilitic individual remains throughout his life potentially aneurysmal.

In 150 cases at the Cleveland City hospital there were 68% which occurred in the fourth and fifth decades of life (17).

It is emphasized by Kampmeier (36) that age in itself is a minor factor and it is the latent period between initial infection and the signs and pathology associated with cardiovascular syphilis that is important.

"Aneurysm of the thoracic aorta is 5.6 times as common in males as in females (7). All statistics give males a marked predominance although the figures vary from 10 to 3 up to 11 to 1."
Aneurysms may be seen at any age. It has been reported in the infant and in the very aged. The curve of incidence rises slowly from birth and reaches a maximum in the period from thirty-six to forty years and then falls more slowly. While aneurysm is usually discovered in the years of greatest physical activity, it must be considered as a diagnostic possibility at any age. In 3690 cases, the exact age was stated and 1719 or about 75% were between ages of thirty and sixty.

The colored race is notoriously liable to aneurysm, probably due to the increased incidence of syphilis in the race and neglect of treatment.

Occupation requiring sudden violent exertion precipitates many latent aneurysms but probably does not cause them. It is probable that the association of syphilis, alcohol, and hard work in the same type of individual is more important than occupation itself, although there has been a sufficient number of aneurysms found in non-syphilitic children (usually suffering from whooping cough) to warrant the view that stress and strain play more than a minor part in some cases.

However Hirschfelder (25) says, "No change of pressure during life is sufficient to dilate an artery to the proportions of even the smallest aneurysm". According to the elasticity curve of Roy (cit. (25)) the dilatation
occurring between 120 and 110 mm. Hg. is about 20% of the diameter of the artery, and the results of Grehant and Quinquaud (cit. (25)) show that little further dilatation occurs or higher pressures until the artery ruptures at a pressure of 1680 to 4530 mm. Hg. 10-20x blood pressure during life.

Recently Katz and Simpson (cit. (29)) subjected fresh aortas from cadavers to 1000 to 3000 mm Hg. without rupture.

Dr. Osler impressed upon his classes the essentials of cause in the production of aneurysm (11). Venus, Bacchus and Vulcan constituted his etiologic triad. The importance of Vulcan has been underestimated. Natives of the tropics with plenty of Venus and Bacchus but too lazy to work do not have aneurysms very often with their syphilis. We might add Mars, the god of war to Osler's three for war has always been the great spreader of syphilitic infection. The greater the incidence of syphilis in populations "addicted" to heavy work the greater the incidence of aneurysm.

Although the treponema pallidum has been repeatedly demonstrated in the aortic lesions and in the tissues of the wall of the aneurysm the organism is not always easily found (39). This parasite doesn't permeate the injured areas in the aorta, nor does it persist in the
old scarred areas. We have discovered it mainly in the advancing borders, grouped in small clusters about the inflammatory reactions near the vasa vasorum.

There is no longer any dispute about the definite relationship between the type of aneurysm which we are discussing and syphilis (40). Definite though this may be it leaves us in the dark on three points:

WHY is there the peculiar predilection for the supra-sigmoid portion of the aorta?

WHY the extremely long latent period, approximately 20 years, between initial infection and the appearance of cardiac signs and symptoms?

WHY the difficulty in demonstrating the treponema pallidum in the aortic lesion even when the disease is well advanced?

While various theories have been discussed by different writers, no convincing answers have been forthcoming. It is perhaps better to recognize the fact these are still unsolved problems at the present time.
SYMPTOMATOLOGY

With the development of an aneurysm a group of symptoms due to the pressure of the aortic tumor appears, and a number of characteristic physical signs become evident (77).

Symptomatology was noted in 1611 cases by Boyd (7). Pain, a chief complaint, was located in the chest, left shoulder, right shoulder and in the back. For this reason the location of the pain should not be considered diagnostic.

The character of the pain varies a good deal, manifesting itself in one of three forms (58). Anginoid pain, occurring early in the disease, is associated with aneurysm of the sinuses of valsalva or the ascending aorta. Opinions as to the cause of the pain are: stretching of the aorta; and pressure upon the coronary arteries. According to Mills and Horton (49) the angina pectoris is associated with intimal overgrowth at the orifices of the coronary vessels. This pain is often radiated down the arm and associated with numbness or tingling of the fingers and exertion is especially apt to provoke an attack (48).

Pressure pain is the typical pain of aneurysm, but is not present until the growth reaches the chest wall. Many writers have noted that pain due to erosion of the
ribs and sternum is much less marked than erosion of the vertebra. Rarely this erosion of bone takes place without pain (??). In addition to erosion, pressure pain may be seen when there is involvement of nerve trunks. Aneurysm of the descending aorta may present themselves under disguise of an intractable neuralgia. This is particularly liable to lead to other sensory disturbances in affected areas.

The third type of pain is difficult to name and occurs in dissecting aneurysms. It is sudden, terrific pain in the chest, usually associated "with collapse from which the patient may or may not rally" (7). When cases live for more than few minutes, they present usually the clinical picture of a severe angina pectoris and in a short time, hours or days, they have a second attack and death occurs.

Dyspnea is a common symptom seen in a variety of degrees and types. Boyd (7) places it second because in its milder forms it is apt to be disregarded by the patient and elicited only upon inquiry. In its mildest form, it consists of a mere substernal oppression; it is increased upon exertion and indistinguishable from syphilitic aortitis. More severe is the form due to pressure upon the trachea and large bronchi. There is a paroxymal type of dyspnea which is very important.
These attacks may be occasioned by changes in posture and the patient often assumes unusual positions in order to avoid their production. The cause is not known, some attributing the symptom to pressure upon the vagus, others the recurrent laryngeal, but whatever its ultimate etiology it is rarely seen unless there is actual pressure upon the trachea or large bronchi.

Cough is a common symptom of aneurysm is a large number of cases, seen in association with "attacks of colds". The typical cough accompanying the colds is a harsh, brassy cough. Hall (22) compares it to a leopards growl or a rough, glutteral cough.

Usually when cough is present, there is little or no sputum. When arch or descending aneurysms press upon the left bronchus, a large amount of sputum may be noted (7). When sputum is present, it is modified in about one-fourth of the cases by the addition of blood. This bleeding may be of three types: A large hemorrhage due to ulceration through the left bronchus or less commonly the trachea which is fatal in a few minutes; a group in which profuse hemorrhages are seen over a period of months due to leaking of the aneurysm and subsequent blocking of the rent by means of a clot; congestion from a failing myocardium, pressure, pulmonary infraction, or actual rupture into the lung substance. The last row occure just before
death.

Tumor is at times the chief complaint, and its intensity depends on the situation, the rapidity of growth, and its size (58).

Dysphagia is a symptom closely allied to dysphonia. In arch aneurysms it is produced by pressure through the recurrent laryngeal nerve and spasm of the esophagus, which is apt to be transient (77). The lower the aneurysm is upon the descending aorta, the less frequent is dysphagia. As a chief complaint it is not common and is rarely complete.

Loss of weight and loss of appetite are symptoms present only in those cases which have lasted over a long period of time. Loss of weight may be due to a number of causes as pain anywhere in the thorax, pain on swallowing and more rarely pressure upon the thoracic duct (7).

A large aneurysm may press on the esophagus and interfere with entry of food into the stomach, or compression of thoracic duct may cause engorgement of absorbent vessels and glands and lead to great interference with nutrition (22).

Among the most important objective phenomena is found pulsation. The first type of pulsation is the diffuse general shock that may be seen anywhere in the chest,
especially frequent in ascending aneurysm complicated by cardiac hypertrophy due to a concomitant aortic regurgitation (7). The second type of aneurysmal pulsation is diffuse with no distinct shock noted. Pulsations are most frequently noted in the second right or left intercostal spaces or in the back. With the exception of the last, pulsation is not in any way characteristic of aneurysm.

Aneurysm irritating the superior cervical sympathetic may show dilated pupils, widened slits, protrusion of the bulb, or in the state of paralysis may be seen miosis, exophthalmos and sympathetic ptosis. Changes in the size of the pupils may be caused by vascular conditions. More important than dilatation or contraction is anisocoria. Due to this sympathetic irritation sweating and increased redness of the face and in some cases chest and right arm may be present (58).

Involvement of the recurrent laryngeal nerve is a frequently overlooked sign because of inability to make the examination or neglect to do so (58). When involved, it usually is the left that is disturbed and as a rule the cord may be paralyzed a considerable length of time before there is any voice change. Later when the cord passes back into the "cadaveric" position the various types of dysphonia appear (7).
It has been said that "More mistakes are made from want of looking than from want of knowing", and in no complaint is this more true than in aneurysms (23). Diagnosis of aortic aneurysm is notoriously confusing because of its resemblance to and simulation of other chest pathology. And especially the condition is often mistaken for heart disease (58).

Dysynesia, thoracic pain of the various types described heretofore, respiratory, circulatory, laryngeal, paraplegia, hemiplegia (erosion of the vertebrae) and general symptoms are those by which aneurysm is usually diagnosed along with the more or less well known physical findings (22).

In the absence of pulsation or swelling, pain in the precordia is often diagnosed as angina pectoris. Pain in either shoulder or back is often designated by the confusing and meaningless term "rheumatism" which heads the list of wrong diagnoses. Pain in the intercostal spaces is often labeled neuralgia where by a symptom is confused as a disease. Pulsating empyema has been mistaken for an aneurysm which has eroded the ribs and caused tumor on the thorax. Dysphonia rarely causes diagnostic difficulty because this symptom is rather well understood. In a few cases the diagnosis was
Among general diagnostic points both De Raveland Hall and Mills and Horton (49) report clubbed fingers, bruit, thrill, and abnormal heart sounds. Hall (22) also reports a method of finding tracheal whiff by putting the stethoscope in the patient's mouth and in apnea, hearing a "systolic whiff" when aneurysm is present. Tracheal breathing especially with stridor is an important clue in detecting aneurysm.

Anisocoria, loss of reaction to light and accommodation, miosis or dilatation of the pupils may be caused by the aneurysm interfering with the sympathetic nervous system, or may be due to tabes (22).

Some of the reasons for making wrong diagnoses have been suggested by Boyd as noted in 130 cases (7):

<table>
<thead>
<tr>
<th>Condition</th>
<th>Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rheumatism</td>
<td>32</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>22</td>
</tr>
<tr>
<td>Asthma</td>
<td>18</td>
</tr>
<tr>
<td>Chronic Bronchitis</td>
<td>14</td>
</tr>
<tr>
<td>Pericarditis, pleurisy, carcinoma of stomach and esophagus, chronic laryngitis, tuberculous laryngitis, abscess of the lung, pleural effusion, and empyema each 2</td>
<td></td>
</tr>
</tbody>
</table>

A group of radiologists (55) give the most frequent errors in diagnosis as those concerned with pulmonary tuberculosis, asthma, chronic bronchitis, congestive heart failure, mediastinal neoplasm, pleurisy, angina pectoris, and carcinoma of the esophagus. From a purely clinical standpoint, it is easy to appreciate why such errors arise, since these conditions may produce symptoms similar to those caused by aneurysms of the aorta.
Roentgenologists have felt that every suspected chest condition, from whatever cause, should be subjected to careful roentgenoscopic and roentgenologic study and that this closer cooperation between clinician and roentgenologist, with the latter acting in a consulting capacity, will result in more accurate diagnosis (55).

In 1898 within short time after Roentgen's discovery in 1895 X-rays were used to diagnose cardiac enlargement. Macentyre (cit. (65)) was first to write of the use of X-ray in diagnosis of intrathoracic aneurysm.

It would be well to emphasize that not all aneurysms of the aorta are accessible to roentgen study (55). The exceptions are represented by the type arising from the sinuses of valsalva and the small pouch type. But even here the roentgenologist may be of great assistance in raising a suspicion of their presence.

It is interesting to note that a group of roentgenologists say, "we believe that there are no classical pathognomonic symptoms and physical signs of aortic aneurysm and that, while the diagnosis is very often clinically correct, the services of the roentgenologist are of inestimable aid in confirming or ruling out the presence of such a lesion". Obviously the roentgenological diagnosis is the most important part of the examination since size and location are thus accurately determined. Many
aneurysms were first demonstrated by the roentgen ray, and changes in the lungs and related structures which clinically had been thought to be primary were thus shown to be secondary in nature. Pulsations may be seen; but, in our experience, differentiation between expansile pulsations and motion transmitted from the heart has been impossible except in isolated instances. In fact, the great majority of aneurysms do not pulsate, because of disease in the wall, calcification, or the presence of a mural clot. The differential diagnosis of mediastinal and lung tumors is at times difficult. An aneurysm may resemble a tumor in the superior mediastinum, particularly a substernal thyroid. The latter, however, moves upon respiration, swallowing, or grunting and the aortic arch is distinctly separated from it. An enlarged right lobe of the thyroid produces an arch-like displacement of the trachea, with narrowing of the lumen, most marked in the region of the middle superior mediastinum. The left lobe of the thyroid displaces the trachea to the right. The lymphoblastoma group of tumors, such as Hodgkin's disease, lymphosarcoma, leukemia, and thymoma, are usually situated in the anterior mediastinum, and the trachea is very seldom displaced laterally. If the tumor is large enough, there may be a posterior displacement of the trachea. The aortic arch (without adequate films) can usually be separated from the media-
sternal mass. These tumor masses are bilateral, enlarged in the vertical diameter, have indistinct cutlines, and rarely show calcification (55).

A sidelight upon this subject is given by Evarts Graham (21) who reports two cases of congenital aneurysm of the ductus arteriosus. Roentgenologists visualized a tumor in the superior mediastinum, with no pulsation. After operating on these two and losing the first one by puncturing the tumor (he was more cautious on the second one) he concluded that absence of pulsation is of no significance in mediastinal tumors.

Another point in diagnosis is that some thoracic saccular aneurysms produce characteristic erosion in the anterior and the lateral surfaces of the bodies of the vertebrae, (55). Because the intervertebral discs resist the destructive process better than the bodies of the vertebrae, the portions of the bodies nearer the discs are very little involved, producing scaphoid erosion of the bodies with intact overhanging edges. An important finding in aneurysms of the terminal arch is an irregular erosion of the fourth and fifth thoracic vertebrae. It is necessary to note that the erosion is best shown in silhouette in the right oblique position.

Singleton (72) used infections of NaI with rapid roentgen ray exposure on a sensitive plate with aneurysm of
the popletial, brachial and femoral. The information gained was invaluable in regard to blood vessels entering and leaving the aneurysm and collateral circulation, which may be of great assistance in determining method of treatment. With more investigation this may be a valuable adjunct to the present diagnostic methods.
PHYSICAL SIGNS


cite(56) says that good light, good eyes, and a certain method of routine are required for a successful examination. He states the patients are young, or middle aged vigorous-looking subjects. He notes cyanosis, inequality of pupils, distention of veins on the neck, and noticeable thoracic pulsation or tumor pulsation, or non-pulsation as important signs in inspection.

A very important finding of palpation is variation in the pulse (7). From a theoretical standpoint the pulse in the aneurysmal sac should be later than the apex impulse but since the time interval is so short this sign gives practically little information.

Harvey in the De Motu Cordis (cit. (65)) commented on the difference in the pulse on the two sides. However pulse tracing is rarely done unless other signs of aneurysm are manifest.

The complete absence of pulsation in the radial, brachial, and carotid arteries bilaterally is a rare condition. A study of the literature shows only five such cases and only in three was there an autopsy (47). In all of these cases the clinical picture was that of attacks of dizziness and syncope together with absent pulsation in the upper extremities and neck.

Tracheal tugging was first described by Surgeon Major Oliver (56) in 1878; he says, "place the patient in the
erect position and direct him to elevate his chin to the fullest extent; then grasp the circumoid cartilage between thumb and forefinger and use gentle upward pressure, when, if dilatation or aneurysm exist the pulsation of the aorta will be distinctly felt transmitted through the trachea to the hand. The act of examination will increase laryngeal distress should this accompany the disease".

Tracheal tugging is almost pathognomonic of aortic aneurysm but may be caused very occasionally by anything which brings the aorta into abnormally close contact with the left bronchus. So neoplasm here has been known to show this phenomena and also fibrosis of the lung, so it must be used with other symptoms (22).

Von Glahn (77) states that tracheal tugging is very important and that it should be searched for carefully because of the frequency with which it is present in aneurysm and the rarity which it occurs in other mediastinal tumors.

Examination by auscultation of the heart may show the signs of aortic regurgitation, which often accompanies sinus aneurysm. As to the aneurysm proper there are several factors which make for variation in auscultatory findings. Adventitious sounds depend upon the contents of the sac and the conditions of the orifice. Among the positive findings one notes a dull first sound followed by a ringing accentuated second sound (€).
In percussion we have a most important finding, namely dullness. In a majority of instances it is sub- or para-sternal (7). Aneurysms of the sinuses of Valsalva may never reach sufficient size to give rise to change in dullness. However, ascending aneurysms with their large sacs will usually give rise to dullness to the right of the sternum. Arch aneurysms when not too deep will give rise to substernal or left parasternal dullness. However, mere dilatation of the aorta may give rise to this phenomena. In descending aneurysms the dullness may be found in the subclavian space, the axillary space, or more commonly, in the left interscapular and left sub-scapular space. Rarely posterior dullness is mentioned in case reports although nearly every text-book emphasized it. Von Glahn (77) states that even large aneurysms can be present without impairment of the percussion note.
Even today our diagnostic ability frequently exceeds greatly our ability to aid the patient by treatment. There is, however, a paradox concerning the early therapy of syphilis that is difficult to understand. The first period of the history of syphilis was characterized by surprisingly accurate observations of the manifestations and the clinical course of the infection. It is difficult to comprehend, therefore, why the same clinical acumen did not more quickly evaluate the drugs used in the treatment of the disease. Quaicoum, China root, sarsaparilla, sassafras, and many other preparations enjoyed longer periods of popularity than the clinical results which followed their administration justified (27). In contrast, mercury, the only drug introduced during this period which is still used in the treatment of syphilis, held a very insecure place. This was mainly because of the failure to evaluate clinically its effect upon the course of the disease when given in tolerated amounts. The history of its use in the treatment of syphilis is of interest in illustrating this point.

By whom and why mercury was first introduced is still obscure. Although Paracelsus (59) is frequently given credit for its introduction in 1858, there is abundant evidence that it was used at a much earlier date.
Schamberg and Wright (68) state that it was first prescribed by Widman in 1437. It has also been stated that its value in the treatment of syphilis was discovered accidentally as follows: "For some years before 1493 an ointment known as Unguentum Saracenicum, which contained a small amount of mercury, a ninth part, had been used with apparent success in the treatment of scabies. Because of the clinical resemblance of some of the skin lesions of the two diseases, it was thought that this ointment might also be beneficial in the treatment of syphilis. When, as judged by its effect upon the skin lesions of late syphilis, this assumption proved correct, mercury was added to the other antisyphilitic drugs in use. Immediately it was found to be of value, mercurial ointments containing as much mercury as could be incorporated in them were prescribed in the treatment of syphilis. Since the efficiency of mercury was judged to be in direct proportion to the severity of the reactions it produced, gingivitis with loss of teeth, hemorrhagic gastroenteritis, and acute nephritis frequently and death not infrequently followed its administration. It is not surprising that the mercury cure of syphilis was dreaded more than the disease and the drug fell into almost universal disrepute. As early as 1497, mercury was soundly condemned in the treatment of syphilis, and
from 1580 to 1655 medical students at Heidelberg were forced to take oath they would never prescribe it for that purpose. Paracelsus (59) who was credited in France with the introduction of the drug in syphilotherapy, was labeled "the mad man from Germany".

It was more than 250 years after the introduction of mercury before it was properly used in the treatment of syphilis. In 1750 VanSwieten (74) who introduced the use of mercury bichloride orally in the treatment of syphilis showed that satisfactory therapeutic results followed its administration in much smaller and consequently less toxic amounts than had heretofore been prescribed. Why this observation, which depended entirely upon clinical acumen, was not made much earlier is difficult to understand (37).

The object of medical treatment in aneurysmal dilatations is to initiate nature's mode of cure by diminishing the blood pressure, retarding the velocity of the circulation, increasing the coagulability of the blood, and provoking thrombus formation within the sac by agents which act directly upon the aneurysmal tissues from within and without (46). These indications are best met by the dietetic, hygienic, and medical treatment which was introduced by Valsalva and Albertini in 1728, Tuffnell and Billingham, and is still known by these names (cit. (46)
They all aim at accomplishing the first three indications in nearly the same way. The original Valsalva treatment consisted in absolute physical and mental rest, in rigorous diet, 125 grams of food per day, deprivation of fluids, and repeated bleeding, venesection, by which the volume of blood was reduced, the blood tension diminished, and the coagulability of the blood increased. The treatment was continued until the patient was too weak to lift his hand from the bed. (46)

Tuffnell (cit. (22)) about 1870 devised a variation of the Valsalva treatment which consisted of placing the patient upon the minimum rich diet and forbidding even the slightest movement which can be avoided. The room must be as quiet and secluded as possible and no treatment by drugs to be attempted at the same time except those of constipation. Water intake limited as long as pulse and temperature are normal, or nearly so, and the whole allowance of solid food consumed. The duration of treatment must be two months absolute rest; then treatment relaxed only slightly for the succeeding six months. It is important that a person of placid disposition and sedentary habits be selected as it is useless to treat a laborer who has to return to hard work. Alcoholics with degenerate vessels are also poor risks especially if they have syphilitic history. Where there is pressure on
the esophagous or trachea, rest is not well borne in a recumbent position and may result fatally so the aneurysm of physical signs, from first part of arch of aorta, is more suitable for treatment than the aneurysm of the arch of the aorta.

Drugs are chiefly indicated to reduce the frequency of the heart beat and to diminish the arterial tension. Nitroglycerin, tetranitrite, sodium nitrite, chloral, aconite, veratum viride, etc. are all valuable when the pulse is rapid and the arterial tension is high.

Cripp (12) in 1844 states that his treatment of aneurysms consisted of repeated small bleedings, digitalis, and diacetate of lead. He states that the latter two are of little value. He recommends opium for the pain with which some patients are afflicted. A simple sparse diet and rest are equally important.

The one great advancement made in the treatment of syphilis during the nineteenth century was the introduction of potassium iodide (35). Iodide of potassium appears to have been the first used in treatment of tertiary syphilis by R. Williams (cit. (35)) in 1831 and soon was widely used; first by Nelaton in 1859 in and later by Bowland in 1862 on the claim that apart from syphilis it increased the coagulating power of the blood. The rapid involution of the visible lesions of late syphilis which followed its administration gave it
a prestige almost equal to that enjoyed by guaiacum in the early sixteenth century. For a while it appeared as if it would displace mercury in the treatment of syphilis. It was Fournier (16), 1832-1914, who saw the wisdom of using mercury and iodides in conjunction and the advantage of administering these two drugs intermittently over a long period of time. De Haveland Hall (22) in 1913 stated that much iodide of potassium had been given but as yet no cures had been reported. The treatment relieves symptoms for a time but they return and death is sure to follow. It relieves pain a great deal in most cases, but this, he states, is not altogether due to its antisyphilitic properties, but its more mysterious effects of lowering the blood pressure and tachycardia. Adequate dosage, 20 to 40 grams daily, is needed and, according to De Haveland Hall, the failure of the drug is due to inadequate dosage as much as any other factor.

Of the numerous astringents and coagulants formerly prescribed, none remain except the names. The only remedies of this class that deserve mentioning are gelatin and calcium chloride as their function was thought to be the coagulation of the blood (46).

1897 M. Lancereau (41) of Paris published a new treatment of aneurysm. He injected 20 grams of gelatine suc-
cutaneously, repeated every three or four days. He claims to great relief from pain and diminution in the tumor mass. "The temperature may rise to 103 or 104 degrees and although very alarming no evil will result from it". This treatment was poorly received in England because of many cases of tetanus which resulted from improper sterilization of the gelatine.

Rankin (64) states that gelatine injections with proper precautions may be given subcutaneously with safety. He claims that in several cases injections of gelatine relieved all symptoms and in some the objective signs. His theory of the mechanism of the treatment is a shrinkage of the size of the sac with increased resistance of the wall sac.

In 1900 Sir Oswald Browne (10) at the Society of Medicine London advocated calcium salts such as calcium chloride and calcium lactate in hopes that they would favor coagulation of the blood. There is only one report giving this treatment a beneficial result.

The modern medical treatment of syphilitic aneurysm, as has been noted before, has been revolutionized by three factors: the discovery in 1905 by Schaudin (69) that the spirochetae pallidum was the etiological agent; the Wassermann fixation test (78); and the laborous research of Erlich (10) in the discovery of Arsphenamine.
The time to begin treatment of aortic syphilis is during the primary stage or early secondary stage of syphilis (20). In other words, if syphilis itself is treated early, the incidence of aortic syphilis is reduced to the vanishing point. If one waits until the signs or symptoms of syphilitic aortitis appear, such extensive damage has already been done that the physician cannot hope to do more than relieve symptoms, or at most, to retard the progress of the disease.

When symptoms of syphilitic aortitis have appeared, intensive antisyphilitic treatment should be instituted. The drugs which are universally employed are mercury, bismuth, potassium iodide, and one of the arsenical compounds (20). Mercury, bismuth, and arsenic have definite spirocheticidal action. The iodides possess no such power, but are useful in the latter stages of syphilis.

A course of treatment consists in the administration of mercury or bismuth for a period of twelve weeks, and six to eight doses of an arsenical compound, while potassium iodide is being given. Two or three such courses are given in a year, with intervening rest periods of six weeks.

The signs of improvement under such treatment are: amelioration or complete disappearance of the symptoms of syphilitic aortitis, such as paroxysmal dyspnea, an-
original pain, and substernal discomfort; and improvement in the general condition of the patient. The appetite improves, the weight increases, and the blood picture becomes normal. The Wassermann reaction does not necessarily become negative (20).

When cardiac decompensation occurs during the course of syphilitic aortitis, it should be managed precisely like cardiac failure under other circumstances.

The treatment of aneurysm, which is essentially that of syphilitic aortitis, should be carried out intensively. For the aneurysm itself, in the early stages at least, much may be accomplished by rest, rest in the recumbent posture, for as long periods as ten to twelve weeks. This diminishes the rate and force of the heart and consequently reduces the volume of the sac, which in turn relieves the subjective symptoms. When the patient is finally allowed up and about, exercise must be restricted and physical strain reduced to a minimum.

The diet should be restricted to the quantity sufficient to maintain the nutrition of the individual. There is no advantage in restricting the fluid and food intake rigidly as in the Tuffnell regime.

Alcohol and tobacco are to be interdicted.

The various measures to increase the coagulability of the blood which have been suggested, such as frequent small bleedings, and the administration of calcium lactate,
gelatin, etc. are of little value (20).

To relieve pain due to the erosion of bone, local
applications of heat, in the form of flaxseed poultices,
or an ice-cap applied directly over the seat of the dis-
comfort may be helpful. For the more severe neuralgic
pain, or the attacks of angina, morphine must be admin-
istered hypodermically, in quantities sufficient to bring
relieve.

Paroxysmal dyspnea may in some instances be controlled
by the administration of the nitrites. If the paroxysms
are repeated at frequent intervals, morphine or chloro-
form inhalations must be employed (20).
The surgical treatment of aneurysm consists of measures applied directly to the aneurysmal sac (46). These include compression, acupuncture, filipuncture, electro-puncture. These methods are only semisurgical or quasomedical as long as they do not include the open sections of the tissues in order to approach the aneurysm directly. The strictly speaking surgical methods, apart from the above, are the classic operations, the ligature, in its various applications, above and below the sac; the occlusion of the parent artery by constricting appliances; gradual occlusion; Halsted's bands; gradual compression with graded clamps; elastic ligatures; the radical operations, as by incision of the sac, aneurysmectomy with its larger modifications.

In the preantiseptic period, when all operations involved serious risk, compression was regarded as the method of election in the treatment of aneurysm. The object of pressure is to bring about consolidation of the aneurysm by the formation of either a laminated or an ordinary coagulum. The methods of bringing this about may be considered as direct pressure on the aneurysm, indirect or direct pressure either on the artery or the artery below or on both simultaneously.

Compression of the artery above the aneurysm, or
indirect pressure, was first applied in 1784 by Desault (cit. (46)) who was likewise the forerunner of John Hunter in the ligation of the artery above and at a distance from the sac. It was not frequently adopted, however, until 1844, when it was brought more prominently to professional attention by several Dublin Surgeons, and by the great authority of Broca in France, who warmly advocated in 1863. It is applied to the artery above, the artery below, or to both at the same time. In either case its object is to promote the coagulation of the sac contents. Its mode of application may be classified into digital pressure; instrumental compression; elastic compression; and compression by flexion (46).

Direct pressure over an aneurysm and limited to its surface is now never practised. Efforts to control the growth of a thoracic or abdominal aneurysm by compression have proved disastrous, being followed by embolism or by rupture into the internal cavities of the body (46).

The various methods of ligation of the artery proximal to the aneurysm depend on a decreased pressure and clotting within the sac for their curative effect, a result not always achieved because of the development of collateral circulation (28). Historically, specific names have become identified with certain ligations. Antyllus (cit. (28)) a Roman of the third century, A.D. is credited with having ligated the vessel proximal and
distal to the aneurysmal sac, following which the sac was opened and evacuated. Anel of Toulouse (cit. (22)) in 1710 described ligating the artery just proximal to the sac, whereas in 1786 John Hunter first employed his classical operation in Hunter's canal for a popliteal aneurysm. Anel's ligation is performed at a site likely to be involved in the pathologic process, whereas the Hunterian ligation is performed at a point where the vessel wall is normal, thus reducing the danger of erosion of the wall and secondary hemorrhage at the site of the ligation.

Bras dor (cit. (28)) a French surgeon, in 1760 advised ligating the artery distal to the aneurysm. If there are no branches of the vessel between the aneurysm and the distal ligation, this should be an excellent procedure, inasmuch as Halsted (cit. 28)) has shown that there is very little pulsation in the part of the vessel lying between the ligature and the first branch proximal to the ligature. This being true there should be little pulsation in the aneurysmal sac which lies proximal to the ligature. Distal ligation is applicable to aneurysms of the aorta and iliac, innominate, carotid, and subclavian arteries.

All ligations have an inherent defect; they do not attack the aneurysmal sac directly (46). Extirpation
of the sac has been repeatedly advocated, but the dangers are real. Adjacent structures, such as nerves, may be so intimately bound to the sac that its excision would endanger the distal nerve supply. Moreover, such excision would endanger the collaterals present in the tissues surrounding the aneurysm. Both these defects are remedied by the excellent operation of Matas (44), first used by him in 1889 and since applied with remarkable success in many hundreds of cases. The operation depends on the feasibility of completely controlling all circulation through the sac by the application of a tourniquet or by the application of arterial clamps to the vessel proximal to the sac. In the case of a fusiform aneurysm the sac is boldly opened, the clots removed, both arterial orifices and all branch openings are closed by individual transfusion ligatures. The sac is then obliterated by successive rows of ligatures applied to the sac. This Matas (46) entitled the "obliterative endoaneurysmorrhaphy". The sacculated aneurysm is also boldly entered and occasionally the opening from the artery itself can be sutured and its closure reinforced by suturing the walls of the sac over it. This was called restorative endoaneurysmorrhaphy. When preservation of the main channel would seem necessary for life of the limb, Matas (44) advocated the reconstructive endoaneu-
ryorrhaphy; the continuity of the parent artery may be restored by making a new channel out of the sac walls, which can be brought together by suture over a guide (catheter or drainage tube) inserted into the proximal and distal openings of the aneurysm. Before tying the last suture the guide is removed and the channel is left behind, corresponding to the outline of the original artery. Even though such a passage may ultimately close by clotting, the temporary assistance to circulation through this restored artery may be sufficient to prevent gangrene.

On June 25, 1817 Sir Astley Cooper (cit. (75)) ligated the abdominal aorta for left ilio femoral aneurysm in a man 38 years of age. Death took place in three days. Since that time there have been about 20 attempts at ligation of the aorta (9). Some of these early intrepid experimenters are: Jones, 1829; Murray, 1834; and Monteiro, (1842). Some causes of death were shock, gangrene, ligation of ureter, ligature cutting through the vessel and hemorrhage, infection of the bowel, etc. (cit. (75). In 1899 W.W. Keen ligated the abdominal aorta just below the diaphragm for ruptured aortic aneurysm. Death occurred in 48 days from the ligature cutting through the aorta with hemorrhage. On June 20, 1904 A. Guinard (cit. (75)) ligated the thoracic aorta about the level
of the ninth thoracic vertebrae; death occurred in three days from suppression of urine.

In April 1906 R. Lozano (cit. (75)) ligated the abdominal aorta by the method of Matas endoaneurysmorrhaphy. The patient lived eight hours and died from shock and hemorrhage due to sutures cutting through the diseased walls of the vessel.

Geo. Tully Vaugh (75) in 1921 claims credit for one of the only successful ligations of the abdominal aorta for aneurysm. In 1919 he tied the abdominal aorta just below the inferior mesenteric artery with a piece of tape. After one year and four months the patient was well and happy. J. Shelton Horsley (abst. (9)) in 1926 said that this patient lived two years and one month after the operation. Post mortem showed that the aneurysm was not cured, but benefited.

Rudolph Matas (45) reported in 1925 that he ligated the abdominal aorta in a patient of 28 years just above bifurcation for bilateral iliac aneurysm. He used cotton tape suture. The patient died seventeen months afterward of fulminating tuberculosis and rupture of branch of pulmonary artery. In the autopsy the aorta was found to be only partially occluded. Matas says that cotton or silk bands stay better, are less likely to cause premature ulceration, atrophic or necrotic
changes in the artery wall which may end in disastrous hemorrhage. There was no necrotic or degenerating changes in the intima here but a dense capsule of fibrous tissue of new formation which strengthened the vessel wall. Fascia or other less available material would seem a superfluous resort.

If the parent vessel of an aneurysm could be satisfactorily occluded slowly enough to permit a concomitant development of satisfactory collaterals, a great step forward in the treatment would be taken. Falstead (cit. (5)), 1905, devised a method. It consists in brief, in partially constricting the vessel by means of an instrument especially constructed for that purpose. The idea being that when the lumen had been perhaps not quite occluded complete obliteration might result spontaneously with the conversion of the arterial wall embraced by a band into a solid cylinder of living tissue. This may be considered the ideal closure of an artery.

According to Emilie Holman (28), however, erosion of the arterial wall under the aluminum band is an ever present danger.

Halstead (23) in 1918 found there is frequently dilatation of the vessel on the distal side of the band which is due to formation of eddy currents in the partially obstructed current.
Less dangerous is a narrow strip from the fascia lata which may be employed for partial occlusion by wrapping it twice around the artery and suturing the ends together. Recanalization of the artery occurred, however, so the method was not too successful (9).

Barney Brooks (9) an eminent authority on aortic ligation, gives the problems of ligation of this large vessel as inability to obstruct vessel without constricting material cutting through vessel, and a knowledge of an already existing collateral circulation or of a method of its production before complete obstruction. Brooks concluded that operation is possible and compatible with life if collateral circulation is present. Absence of pulsation of femoral artery shows that collateral circulation is present and indicates, operation is successful. The present method of obliteration is bad as silk suture will cut through and fascia is soon relaxed and will not hold. We say most patients die because of heart strain in forcing blood through the collateral circulation, so surgical ligation is not so good. Matas operation is better in most cases, except in aortic aneurysm as sutures will not hold in the diseased tissue.

Aseptic acupuncture (needling), practised by Macewen (43) in 1890 for inoperable aneurysm, consists in the introduction of a long needle into the aneurysmal tumor,
where it remains twenty four hours, during which the needle is moved sufficiently to scratch the intima and produce sufficient irritation to induce the formation of white or plate-leukocyte fibrin thrombi. The method is practically abandoned on account of its uncertainty, the difficulty of limiting the effect of the puncture to the internal surfaces, and the fact that the aneurysm is already lined with laminated clot (46).

In 1864 Charles H. Moore (51) put the first retained wire into an aneurysm. This treatment was widely used. In 1879 Corradi (cit. (30)) modified this treatment by passing a galvanic current through the wire. The Moore-Corradi treatment has been used by Dr. Finney (cit. (30)) of Baltimore, and others, a great deal during the past few years. Briefly Finney's technique is as follows: he uses a silver and copper alloy wire wound on a spool to make it coil as it passes through the aspirating needle. The needle is coated with laquer to prevent burning the tissue with necrosis and hemorrhage. Under local anaesthesia the needle is put into the sac and a 75 milli amp galvanic current passed through the wire and the needle is withdrawn; the wire cut and left inside.

About 1903 Colt (62) devised a method by which a number of pieces of flexible wire could be introduced
into the aneurysm through a cannula and when in the aneurysm opens up as an umbrella or wire cage and thus reinforces the aneurysm.

R. Sleigh Johnson (34) concluded that the causes of failure in wiring are the lengths of operation, the severity of hemorrhage, the lack of control over coils of wire which have sometimes entered heart or main branches of the aorta and sepsis.

Rawley Penick, Sr. (61) uses a spinal puncture needle and puts it into the aneurysm under the fluoroscope. He then uses continuous wire loops which he watches go into the aneurysm by the fluoroscope putting two feet at a time in until about ten feet is put in, checking with fluoroscope after each two feet is put into the aneurysm. The results are good with no deaths. There is a disappearance of pain and pulsation ceases. The patient resumes his normal activity after a month or so of rest.

Blakemore and King (6) attempted a method in which the blood velocity, not the size of the aneurysm, indicates the amount of wire necessary to retard the amount of flow to the patient at which complete mass clotting takes place. Former methods of wiring aneurysms gave no index of blood velocity as a guide to the amount of wire necessary in a given case. Blood circulation under pressure creates a strain on the wall of the sac
varying with the square root of its surface area and to a lesser extent with the rate of blood flow. Doubling the diameter of an aneurysm increases the strain on the sac 100%. The stretched sac, further devitalized (as its nutrition and strength depends largely on an outgrowth of collateral vessels about the neck), is of course weakened. In a clotted aneurysm, however, the physical laws governing solids obtain. Thus the strain on the sac of an unclotted saccular aneurysm multiplies with growth, whereas filling the sac completely with a solid clot reduces the strain on the sac to that of the lateral wall pressure on the surface area of the mouth of the sac (6).

Inactivation of an aneurysm by clotting cannot be accomplished without bringing about two important conditions: presence of an adequate clot stimulating surface; and sufficient reduction of the velocity of blood flow. Heated wire introduced into an aneurysm decreases the blood flow and also offers an excellent clot stimulating surface of protein coagulation. Blakemore and King (6) selected an alloy of 90% silver and 10% copper in 34 gage which has the proper electrical resistance for heating. The small size (one half the size formerly used in wiring aneurysm) and its lack of spring make it safe to use in adequate amounts.
By a clever mechanism which Blakemore and King call a "wire reel", they are able to pass about 33 feet of wire into an aneurysm in four minutes by bending the wire sharply in the center of the 33 feet length and passing it double through a special needle thus forming loops of wire inside the aneurysmal sac. Since the operator knows the temperature changes can be followed by bridge measurements. The current required to heat the wire to any desired level is dependent on two factors: the amount of wire and the rate of cooling, which is dependent on rate of blood flow. By calculation a good index of the velocity of blood flow is obtained. The amount of wire necessary for clotting of blood in the sac can be directly computed and the variety of aneurysm can be determined.

Adherence to the sac wall of a clot deposited within an aneurysm is imperative and its organization desirable. Wire alone may reinforce the blood clot, but heating to 80 degrees wire on the inside surface of an aneurysm sac may cause inflammation of the sac wall.

Tissue subject to a temperature of 80 degrees for a few moments reacts within 24 hours with dema, vascular engorgement, dilatation and a typical inflammatory reaction on the part of the white blood corpuscles. The peak of the inflammation is reached in from two to six
days. This is followed by a period of repair in which fibroblasts appear and tissue organization takes place with the aid of budding capillaries. The entire reaction occupies from ten to twelve days. For this reason they repeat the wiring of the more active aneurysm at twelve or fourteen day intervals. They say that this repetition has the added advantage of determining the progress of clotting.

Blakemore and King (6) conclude that thoroughly clotted aneurysm may be inactive; their method is safe and efficient; heating to 80 degrees within the sac wall promotes adherence and organization of the clot deposited. They have seven living examples of their work relieved of pain and symptoms.

W.W. Babcock (2) states that ligation is harmful from the standpoint of hydrodynamics. And wiring, he claims is dangerous and uncertain. So he devised a method of decompressing sortic aneurysms by dividing the common carotid artery and the internal jugular vein in the neck, and having ligated the distal ends, have united the cardiac ends of the vein and artery. Thus, a bypass is provided permitting the blood to pass from the high pressure arterial system to the low or negative pressure of the descending vena cava and a leakage is provided from the aneurysm and adjacent gessel. Due to this leakage
the blood passes more rapidly through the aneurysm, the wall pressure of which is reduced; the systolic blood pressure falls; the aneurysm becomes smaller; the auricles of the heart fill in a much shorter time and thus "the law of the heart" is reduced. The pulmonary arteries carry partially oxygenated blood and the respirations are slowed. The strain on the arterial system is lessened and danger of enlargement and rupture is decreased.

There have been about 50 of these done by various surgeons (1932) and Babcock claims relief from pain, and increased length of life. He claims there is no cerebral degeneration (at least in dogs).

As an alternative or if the first operation should not give a sufficient degree of decompression, Babcock (3) considers the possible use of the subclavian vein on the opposite side of the neck; or the subclavian artery and vein may be used. Babcock claims that a lateral or side to side anastomosis between artery and vein may do great harm. The effect is quite different from that of an end to end union, which is the only type to be considered as a therapeutic measure.

Saleeby and McCarthy (66) report in 1938 that although the present treatment of internal aneurysm is unsatisfactory, they have found that the Babcock procedure offers the best means of alleviating the symptoms of intra-thoracic and subclavian aneurysms untreated by other means.
The average duration of life after the onset of symptoms may be from one to two years with aneurysm, but there is great variation (38). Associated hyperpiesia about double the changes of complication and mortality. Hard manual labor is bad for prognosis in aneurysm.

About one half of aneurysms end in rupture. Treatment doubles the life expectancy if done correctly, but it is not clear how much the apparent effects of treatment are due to the selection of patients (38).

Syphilitic aortic aneurysm which do not involve the aortic valve area may be present without heart failure whereas aneurysms involving the aortic valve frequently result in death from myocardial insufficiency (19).

In reference to duration of the symptoms, Boyd (7) studied 830 unselected cases. 312 of them were under three months which he says is undoubtedly high because the ones which run a short course are more likely to be reported. Two types of aneurysms run a short course; those of the sinuses of valsalva which rupture early, and early deaths due to undetected descending aneurysm. These statistics are misleading in that any aneurysm, depending on the type, may last a variable length of time.

Average duration of time before diagnosis was made
is 36 months (49). The more remote from the heart the longer the time before diagnosis.

Death in aneurysms maybe due to any of three causes: First those which die of some disease separate and distinct from aneurysms, which are not too common. Secondly those who die from rupture of the sac. This group constitutes about 52% of the deaths. There is a high percentage of pericardial ruptures. The left pleura and esophageous rank next to pericardial ruptures. The third type is due to mechanical effects of the sac, such as heart failure, erosion of the spinal cord, and compression of the azygos major causing pleural effusion and its complicating factors. Chronic pneumonia is a frequent cause of death (7).

Garvin and Siegal (19) report of a rare condition, cor-pulmonale due to obstruction of the pulmonary artery by aortic syphilitic aneurysms causing a burdening of the right side of the heart resulting in hypertrophy of the right ventricle, the so-called cor pulmonale. These are aneurysms of the ascending aorta which are involved. The cor pulmonale has its own type of exitus well described in many textbooks of medicine.
CONCLUSIONS

Aortic aneurysm is not rare.

The etiology concerns syphilitic infection and weakening of the medial coats of the aorta plus a strain.

75 to 90% of aortic aneurysm is syphilitic.

The present treatment of aortic aneurysm per se is unsatisfactory but aneurysms can be prevented by adequate treatment of early syphilis.

Early diagnosis is difficult because of its confusion with heart pathology and in spite of the valuable adjunct of roentgenology.

Prognosis is poor.
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