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Syphilitic aortic aneurysm

Estel E. Surber
University of Nebraska Medical Center

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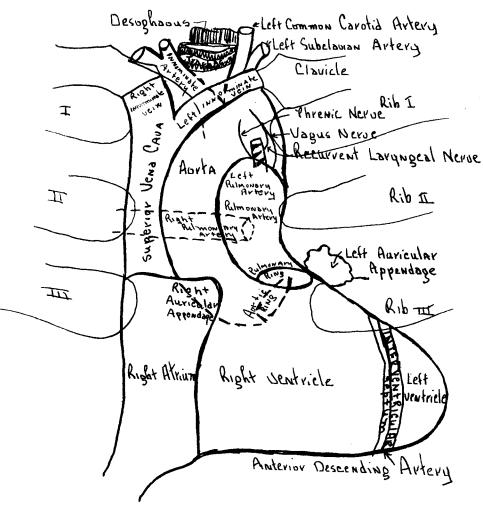
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SYPHILITIC AORTIC ANEURYSM

BY

E. GEORGE SURBER

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CONTENTS

ASCENDING AND ARCH OF AORTA AND RELATED STRUCTURES
ANTERIOR VIEW

Desophaous — Left Common Carotid Artery
Left Subclavian Artery
Clavicle
Innominate Artery
Right Innominate Vein
Left Innominate Vein
Superior Vena Cava
I
Phrenic Nerve Rib I
Vagus Nerve
Recurrent Laryngeal Nerve
Aorta
Left Pulmonary Artery
II
Pulmonary Artery
Rib II
Right Pulmonary Artery
Left Auricular Appendage
Pulmonary Ring
III
Right Auricular Appendage
Aortic Ring
Rib III
Interventricular Septum
Right Atrium Right Ventricle Left Ventricle
Anterior Descending Artery

From (55)

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 de-
fined as a cyst-like mass containing blood and communicat-
ing 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 aneu-
rysm 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 arterio-
venous aneurysm is an abnormal communication between an
artery and vein. Of these there are two types: traunatic
and congenitial 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 capill-
aries and as a result the vein becomes dilated. Any
artery may be the site of such a dilatation, but in prac-
tice we may distinguish aneurysms of the aorta and its

main branches, aneurysms of the arteries of the abdom-
inal viscera, the limbs, and of the brain. There are
several types of aortic aneurysm of which we shall dis-
cuss the syphilitic aortic aneurys m in this thesis.
There are also the rhumatic (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 dis secting 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.

HISTORY and ETIOLOGY

In the Orient a very ancient knowledge of aneurysm is claimed. According to Edmund Owen (cit. (26)), the Hindu surgeon Susruta 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 Chaun, 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 deseases 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 scarely 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 dil-
atations 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 arter-
ial 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 Cannon it is called by

"mater sanguinis", a sea or sac of blood; other names being "burismus" and "operisma", probably through the errors of coypists.

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. Ferneliue 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 referfing 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 he 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 Pare's description of aneurysm, there ap-
peared to be some confusion as to the actual nature of
the tumor. Sennertus (cit. (39) in 1628 again drew atten-
tion to the differentiation between subcutaneous and in-
terstitial blood effusions and aneurysm. He attempted
an explanation for the mode of origin of aneurysm and in-
dicated 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 bourne in upon that syphilis was an unknown
disease at that time (39). It is probable, and the re-
ports 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 impor-
tance was insufficient to lead to much comment. The aneu-
rysms of the first fifteen centuries of the Christian era
appear to have been mainly those attached to the peri-
pheral 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 obser-
vations of the new medicine beginning with these times.
However, the history of aneurysm, because of the intimate
relation between its important types and syphilis, foll-
ows 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 syph-
ilis through all ages.

For brief consideration the history of syphilis may
be roughly divided into four periods (37): the first ex-
tends 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 fin-
ally established. The third period includes the years
following the establishment of the French school of syph-
ilology by Riccord, 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 challange
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 sail-
ors a year previously and while still in America. For
some years following, this phyxsician claimed to have had
an opportunity of seeing the spread of the disease and
of studying many cases in Lisbon. He collected his ob-
servations 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 be-
fore 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 re-
port to Charles V, he stated that the disease was con-
tacted 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 syph-
ilis was prevalent in Europe prior to the return of Col-
umbus. 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. Accord-
ing to Pussey (63), Virchow, who was almost as noted an
anthropologist as he was a pathologist, stated as late
as 1896 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 obser-
vation 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 aneu-
rysm (57).

The first description of the gross pathology of syph-
ilitic aortic disease was noted by Morgagni in 1725 (cft.
(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 formulated 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 ero-
sion 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 aneu-
rysms. Further he believed that "Mercurial fluid" in
the vessels cause distention of them much as it causes
swelling of the salivary glands. Lancisi knew that
aneurysm interfered with blood flow through the arteries
which may cause gangarene of the extremities. He laid
great stress on mental disturbances causing aneurysm,
calling them hypochrondiacal 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 speci-
mens 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 fair-
ly 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 dilata-
tion and partly by rupture. He gave as his opinion that
aneurysms 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 op-
eration of venu-puncutre, the knife is by accident driven
through the vein walls into the underlying artery. This,
he found, led to the permanent establishment of a com-
munication 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 cir-
culation 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 suf-
ficient importance to attract attention are for the most
part located within the chest; nor has the type of aneu-
rysm 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 dom-
inated the second period of the history of syphilis that
it is aptly called the Hunterian period. It is unfor-
tunate 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 etioloty of syphilis and gnorrhea. 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 infedtions 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 gon orrhea 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 aneurysm 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 impetue 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 foll-
owed 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 ar-
tery. 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 6f 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 6f 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 impor tant 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 irre-
futable 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 aneurys-
mal pouches in these luetic aortas." Syphilis amongst
soldiers had always been ac cepted as high in incidence
but it had never been so forcefully shown that the in-
fe cted groups had a definitely high percentage of inter-
nal 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 aneu-
rysms 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 posioning, passions of the mind,
blows, and lifting heavy burdens were origins of aneu-
rysms. 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 dis-
ease of the aortic coats may retrogress-- but if exten-
sive or severe, as a rule it is followed by one of three
fatal phases; formation of aneurysms, implication of aor-
tic 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 ex-
pressed 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 micro-
scopic 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 Britian 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 pallieum; 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 portassium tartrobismuthate was promptly confirmed.

PATHOLOGY

Before the discovery of the circulation of the blood
in 1628 no adequate understanding of the pathogeny of
aneurysm was impossible (11). The real story of syphil-
itic 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 relation-
ship to syphilis.

For some years before this it had been held that syph-
ilis played an important role in the production of aneu-
rysm. Ambrose Pare in the sixteenth century was the first
to suggest this. Lancisi in 1728 spoke of a venereal aneu-
rysm, 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 act-
ual pathology and to lay the foundation for a real under-
standing of the disease as it affects the aorta. His
publication was strongly contested, then forgotten.
Ten years later Dohle (cit. (40)) published a comprehen-
sive 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 per
centage of syphilitic fetus and the finding of the trep-
amona 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 basise.

If we think of an artery as having all the coats of
an automobile tire , we are able to understand the mech-
anism 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 poss-
ible 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 an d 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
vasorum. 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 mus-
cle and elastic tissue of the media. Instead of expan-
sile 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 endarteri-
tis and periarteritis of the smaller arteries, in assoc-
iation with infiltration of lymphocytes and plasma cells
around them, these changes being brought about by the
presence of treponemes in the adventita. This is the
case wherever syphilitic disease occurs and when the aor-
ta is attacked the lesions are essentially in connection

with the vasae vasorum appearing first in the adventitae
and then invading the media. Owing to the important re-
sults in the latter, the lesion is sometimes spoken of
as syphilitic mesaortitis. The initial lesion is the
formation of a plaque or area of thickening in the in-
tima, of greyish-white color and somewhat translucent
appearance. Such plaques are often of considerable thick-
ness 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 (11).

Localized depressions which are potentially the com-
mence ment 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 in-
volved first and disease may have two serious results.
It may lead to narrowing of the orifices of the coron-
ary arteries or it may spread to the aortic cusps, pro-
ducing 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 le-
sions occur, too at a lower level, but it is not uncom-
mon 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 exten-
sion 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 exam-
ination.

The earliest histological change, then, is to be found
as a cellular infiltration around the small vessels in
the adventitia, attended by periarteritis and endarter-
itis. 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(11).

Syphilitic aortitis, the precursor of aneurysms, with
rare exception begins in the supra sinus aort= just above
the aortic valve (5$). It may remain localized as an un-
complicated aortitis; or more often, it extends downward
to involve the commissures and valves in rather a typi-
cal manner. The ascending aorta and aortic arch are well
supplied with lymphatics and the invasion of the aorta
occurs through these lymphatics accompaning 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 in-
stances 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 aorti-
tis 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 s yphilitic 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 syph-
ilitic 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 1 thoracic in over 3000 cases reviewed by Boyd (7).
Aneurysms of the ascinding aorta has been divided into
two types: of the intrapericardial portion (aneurysm
of symptoms) and of the extra pericardial portion (aneu-
rysm of physical signs) (5£). 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 uhless
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 ori-
fices 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 "aneurym
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 overlook-
ed. 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 examina-
tion 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 pathognomic but only suggestive.

Aneurysm of the lower descending aorta is another aneu-
rysm 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 dil-
atations 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 occur-
rence and runs a benign course without pressure phenomena)
and , saccular which is a luetic infiltration with thin-
ning of a discrete portion of the aorta (55). 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, beaause theik 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. Onĉe 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 fol owing way: It cuts off blood supply to the neighborhoodbecause 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 aneu-
rysm 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 defected some-
what from these typical diredtions.

Of all the aneurysm 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 in-
volve the vertebrae. The compression and resultant clin-
ical symptoms may be due to any one of three occurrances:
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 invol-
ved in adhesions to the aneurysmal sac. The micro or-
ganism of syphilis, like that of tuberculosis possesses
the remarkable ability to survive over long periods of
years in the human body without producing demonstratable
physical signs or clearly defined subjective symptoms (54).

From the pathological standpoint, it was th ought in-
teresting 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 gen-
eral 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 nospital 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 in-
itial 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 in-
cidence rises slowly from birth and reaches a maximum
in the period form 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, prob-
ably 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 im-
portant than occupation itself, although there has been
a sufficient number of aneurysms found in non-syphilitic
children(usually suffering from whooping cough) to war-
rant 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
porportions 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 Qunquaud (cit. (25)) show that little further dil-
atation 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 rup-
ture.

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 syph-
ilis 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 bor ders, 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 lon g latent period, approximately 20 years, between initial infection and the appearance of cardiac signs and sympotms?

WHY the difficulty in demonstrating the trepamona 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 pr oblems at the present time.

SYMPTOMATOLOGY

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

Symptomaltolgy 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 (77). In addition to erosion, pressure pain m 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 toother 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 eti-
ology it is rarely seen unless there is actual pressure
upon the trachea or large bronchi.

Cough is a common symptom of aneurysm is a laorge num-
ber of cases, seen in association with "attacks of colds".
The typical cough accompanying the colds is a harsh, or
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-four-
th of the cases by the addition of blood. This bleeding
may be of three types: A large hemorrhage due to ulcera-
tion through the left bronchus or less commonly the tra-
chea which is fatal in a rfew 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 my-
cardium, 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 esophagous, 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 esophagou^s 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 phenomina is found pulsation. The first type of pulsation is the diffuse general shock that may be seen anywhere in the chest,

espec ially frequent in ascending aneurysm complicated
by cardiac hypertrophy due to a concomitant aortic re-
gurgitation (7). The second type of aneurysmal pulsa-
tion is diffuse with no distinct shock noted. Pulsa-
tions are most frequently noted in the second right or
left intercostal spaces or in the back. With the ex-
ception of the last, pulsation is not in any way charac-
teristic of aneurysm.

Aneurysm irritating the superior cervical sympathetic
may show dilated pupils, widened slits, protusion 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 fre-
quently 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).

DIAGNOSIS

It has beens 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 (22). Diagnosis of aortic aneurysm is notoriously confusing because of its resemblance to and simulation of other chest pathology. And espcially the condition is often mistaken for heart disease (58).

Dyspnea, 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 disignated 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 Haveland Hall and Mills and Horton (49) report clubbed fingers, bruit, thrill, and abnormal heart sounds. Hall (22) also reports a method of finding trachael whiff by putting the stethascope in the patients mouth and in apnea, hearing a "systolic whiff" when aneurysm is present. Tracheal breathing especially with stridor is an important clue in detecting aneurysm.

Anisorcoria, loss of reaction to light and accomadation, 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 diagnosis have been suggested by Boyd as noted in 130 cases (7):

Rheumatism	32	Failing Heart	10
Tuberculosis	22	Mediastinal neoplasm	10
Asthma	18	Endocarditis	4
Chronic Bronchitis	14	Angina pectoris	4

Pericarditis, pleurisy, carcinoma of stomach and esophagus, chronic laryngitis, tuberoulous laryngitis, abscess of the lung, pleural effusion, and empyema each 2

A group of radilogists (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.

Roetgenologists 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 Roentgens discovery in 1895 Xrays were used to diagnose cardiac enlargement Macentyre (cit. (65)) was first to write of the use of Xray in diagnosis of intrathoracic aneurysm.

It would be well to emphasize that not all aneuryms 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 form the
haart has been impossible except in isolated instances.
In fact, the great majority of aneurysms do not pulsate,
becuase 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 medi-
astinum, particularly a substernal thyroid. The latter,
however, moves upon repiration, 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 traches, with narrowing of the
lumen, most marked in the region of the middle superior
mediastinum. The left lobe of the thyroid displaces the
trabhea to the right. The lymphoblastoma group of tumors,
such as Hodgins's disease, lymphosarcoma, leukemia, and
thymcna, 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 dis-
placement of the trachea. The aortic arch (without ade-
quate films) can usually be separated from the media-

stinal mass. These tumor masses are bilateral, enlarged
in the vertical diameter, have indistinct outlines, and
rarely show calcification (55).

A sidelight upon this subject is given by Evarts Graham
(21) who reports two cases of congenitial aneurysm of the
ductus arterosus. Roentgenologists visualized a tumor
in the superior mediastinum, with no pulsation. After
operating on these two and loosing the first one by punc-
turing the tumor (he was more cautious on the second one)
he concluded that absence of pulsation is of no signifi-
ance in mediastinal tumors.

Another point in diagnosis is that some thoracic sac-
cular aneurysms produc e characteristic erosion in the
anterior and the lateral suffaces of the bodies of the
vertebrae,(55). Because the intervertebral discs resist
the destructive process better than the bodies of the
vetebrae, the portions of the bodies nearer the discs are
very little involved, producing scaphoid erosion of the
bodies with intact overhanging edges. An important find-
ing in aneurysms of the terminal arch is an irregular
e rosion 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 roent-
gen ray exposure on a sensitive plate with aneuryem of

the popletial, bracheal and femoral. The information
gained was invaluable in regard to blood vessels enter-
ing and leaving the aneurysm and collateral circulation,
which may be of great assistance in determing method
of treatment. With more investigation this may be a
valuable adjunct to the present diagnostic methods.

PHYSICAL SIGNS

Osler (52) 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 mid-
dle 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 inspedtion.

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 aner-
are manifest.

The complete absence of pulsation in the radial, brach-
ial, 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 postion and direct him to elevate his chin to the
fullest extent; then grasp the circoid cartilage between
thumb and forefinger and use gentle upward pressure, when,
if dilatation or aneurysm exist the pulsation of the aor-
ta will be distinctly felt transmitted through the tra-
chea to the hand. The act of examination will increase
laryngeal distress should this accompany the disease".

Tracheal tugging is almost pathognomic of aortic aneu-
rysm 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 sypmtoms (23).

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 medi-
stinal tumors.

Examination by ausculatation of the heart may show the
signs of aortic regurgitation, which often accompanies
sinus aneurysms. As to the aneurysm proper there are
several factors which make for variation in ausculatory
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 fol-
lowed 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 parasternal (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 paraternal dullness. However, mere dilatation of the aorta may give rise to this phenomina. In descedding aneurysms the dullness may be found in the subclavian space, the axillary space, or more commonly, in the left interscapular and left subscapular 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 imparement of the percussion note.

TREATMENT-MEDICAL

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. Guaicum, 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 pre -
scribed by Widman in 1497. It has also been stated that
its value in the treatment of syphilis was discovered
accidentally as follws: "For some years before 1493
an ointment known as Unguentum Saracenicum, which con-
tained a small amoutn 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 benefinicial in the treatment of
syphilis. When, as judged by its effect upon the skin
lesions of late syphili s, 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 incor-
porated in them were prescribed in the treatment of syph-
ilis. 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 bichlorite 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
acument, was not made much earlier is difficult to under-
stand (37).

The object of medical treatment in aneurysmal dila-
tations is to initate nture's mode of cure by diminishing
the blood pressure, retarding the velocity of the cir-
culation, increasing the coagulability of the blood, and
provoking thrombos formation within the sac by agents
which act directly upon the aneurysmal tissues from with-
in and without (46). These indications are best met by
the dietetic, hygienic, and medical treatment which was
introduced by Valsalva and Albertini in1728, 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 originial Valsalva treatment
consisted in absolute physical and mental rest, in rig-
ourous 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 dimin-
ished, 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 minimun rich diet and forbiding 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 allow-
ence 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 im-
portant that a person of placid dispostion and sedentary
habits be selected as it is useless to treat a laborer
who has to return to hard work. Alcoholics with degen-
erate vessels are also poor risks especially if they
have syphilitic history. Where there is pressure on

the esophagous or trachee, rest is not well bourne 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, veratrum viride, etc. are all valuable when the
pulse is rapid and the arterial tension is high.

Crisp (12) in 1844 state that his treatment of aneu-
rysms 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 intro-
duction 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 Bowlland 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 intermit-
tently over a long period of time. De Haveland Hall (22)
in 1913 stated that much iodide of portassium had been
given but as yet no cures had been reported. The treat-
ment 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 antisyphilic properties, but its more myster-
ious effects of lowering the blood pressure and tachy-
cardia. 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 rem-
idies of this class that deserve mentioning are gelatin
and calcium chlorid as their function was thought to be
the coagulation of the blood (46).

In 1897 M. Lancereau (41) of Paris published a new treat-
ment of aneurysm. He injected 20 grams of gelatine sub-

cutaneously, repeated every three or four days. He claim-
to great relief from pain and diminution in the tumor mass.
"The temperature may rise to 103 or 104 degrees and al-
though very alarming no evil will result from it". This
treatment was poorly received in England because of man y
cases of tetanus which resulted from inproper steriliza-
tion of the gelatine.

Rankin (64) states that gelatine injections with pro-
per 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 shrink-
age of the size of the sac with increased resistacne of
the wall sac.

In 1900 Sir Oswal Browne (10) at the Society of Med-
icine London advocated calcium salts such as calcium chlor-
ide and calcium lactate in hopes that they would favor co-
agulation 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 echaudin (69) that the
spiorchetea pallidum was the etiological agent; the Wass-
ermann fixation test (78); and the laborous research of
Erlich (13) 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-

ginal pain, and substernal discomfort; and improvement
in the general condition of the patient. The appetite
improoves, the weight increases, and the blood picture
becomes normal. The Wassermann reaction does not necess-
arily become negative (20).

When cardiac decompensation occurs during the course
of syphilitic aortitis, it should be managed precisely
like cardiac failure under ether 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 consequent-
ly 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 suffi-
cient 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 adminstration of calcium lacate,

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 discomfort may be helpful. For the more severe neuralgic pain, or the attacks of angina, morphine must be administered 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 chloroform inhalations must be employed (20).

TREATMENT-SURGICAL

The surgical treatment of aneurysm consists of measur-
es applied directly to the aneurysmal sac (46). These
include compression, acupuncture, filipuncture, electro-
puncture. These methods are only semisurgical or quas-
medical as long as they do not include the open sections
of the tissues in order to approach the aneurysm direct-
ly. The strictly speaking sur ical 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 appli-
ances; gradual occlusion; Halsted's bands; gradual com-
pression with graded clamps; elastic ligatures; the ra-
dical operations, as by incision of the sac, aneurysm-
ectomy with its larger modifications.

In the preantiseptic period, when all operations in-
volved 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 aneu-
rysm, 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 prominent-
ly to professional attention by several Dublin Surgeons,
and by the great authority of Broca in France, who warm-
ly advocated in 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 pressurep instrumental compress-
ion; 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 compress-
ion have proved disastrous, being followe by embolism
or by rupture into the internal cavities of the body (46).

The various methods of ligation of the artery proxim-
al to the aneurysm depend on a decreased pressure and
clottin within the sac for their curative effect, a re-
sult not always achieved because of the development of
collateral circulation (28). Historically, specific
names hace 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. (28))
in 1710 described ligating the artery just prosimal 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 like-
ly to be involved in the pathologic process, whereas the
Hunterian ligation is performed at a point where the
vess el wall is normal, thus reducing the danger of ero-
sion of the wall and secondary hemorrhage at the site of
the ligation.

Brasdor (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 pro-
cedure, inasmuch as Halsted (cit. 28)) has shown that
there is very little pulsation in the part of the vess-
el lying between the ligature and the first branch prox-
imal to the ligature. This being true there should be
little pulsation in the aneurysmal sac which lies prox-
imal 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 feasiblity 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 transfision 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-

rysmorrhaphy; 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 prox-
imal 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 origin-
al artery. Even though such a passage may ultimately
close by clotting, the temporary assistance to circula-
tion 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 illio femoral aneurysm in
a man 38 years of age. Death took place in three days.
Since that time there have bben about 30 attempts at
ligation of the aorta (9). Some of these early intre-
pid experimenters are: Jones, 1829; Murray, 1834; and
Monteiro, (1842). Some causes of death were shock, gan-
garene, 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. Deat h
occured 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 ab-
dominal 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 mortum 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 fulmunating 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 nectrotic

changes in the artery wall which may end in disasterious
hemorrhage. There was no nectiotic or degenerating
changes in the intima here but a dense capsule of fiber-
ous tissue of new formation which strengthened the vessel
wall. Fascia or other less available material would
seem a superflous resort.

If the parent vessel of an aneuryemcould be satisfac-
torily occluded slowly enough to permit a concomitant
development of satisfactory collaterals, a great step
foreward in the treatment would be taken. Halstead (cit.
(5)), 1905, devised a method. It consists in brief, in
partially constricting the vessel by means of an instru-
ment especially constructed for that purpose. The idea
being that when the lumen had been perhaps not quite
occluded complete obliteration might result spontaneous-
ly 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 dila-
tation 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. Recanilization 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 bility 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 compatable with life if collateral circulation is present. Absence of pulsation of femoral artery show 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. He says 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 acpuncture (needling), practised by Macewan (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 in-
side.

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 aneu-
rysm opens up as an umbrella or wire cage and thus re-
inforces 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 fluroscope. He
then uses continuous wire loops which he watches go into
the aneurysm by the fluroscope putting two feet at a time
in until about ten feet is put in, checking with fluro-
scope after each two feet is put into the aneurysm. The
results are good with no deaths. There is a disappear-
ance 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, in-
dicates the amount of wire necessary to retard the a-
mount of flow to the patient at which complete mass clot-
ing 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% siver 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 diredtly 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 c ause 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 re-ection on the part of the white blood corpusles. The peak of the inflammation is reached in from two to six

days. This is followed by a period of repain inwhich
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 determing the progress of
clotting.

Blakemore and King (6) conclude that thoroughly clot-
ted aneurysm may be inactivate; their method is safe and
efficient; heating to 8ᴧ degrees within the sac wall pro-
motes 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 aortic aneurysms by dividing the common
carotid artery and the internal jugular vein in the neck,
and having ligated the distal ends, have united the car-
diac ends of the vein and artery. Thus, a by pass is
provided permitting the blood to pass from the high press-
ure arterial system to the low or hegative 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 ane urysm 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 anastamosis 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 theraputic measure.

Saleeby and McCarthy (66) reprot 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.

PROGNOSIS

The average duration of life after the onset of symptoms may be from on to two years with aneurysm, but there is great variation (38). Associated hyperpiesis 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 expertance 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 aneuryems 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 undoubtely 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 salsalva which rupture early, and early deaths due to undetected descending aneuryem. 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 er centage of pericardial ruptures. The left pleurs and esophagous 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 com licating 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 un-satisfactory but aneurysms can be prevented by adequate treamtent 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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