DEGENERATIVE VASCULAR DISEASE IN THE EGYPTIAN MUMMY

by

A. T. SANDISON

IT is generally assumed that disease is as old as life itself. This thesis is ably defended by Sigerist (1951) in his monograph on primitive and archaic medicine. The earliest manifestations of disease are seen in fossil bones; changes interpreted as healing fracture, periostitis, osteomyelitis and arthritis have been found in Permian reptiles and continuing through Cretaceous, Eocene, Miocene and Pliocene periods. Similar changes are, of course, also seen in the later pleistocene period, neolithic Europe, Asia and Africa and in historic Egypt and Nubia. Osteoma has been described in a mososaur and in neolithic femora while possible malignant neoplasms of bone have been described in skeletons of the 5th dynasty in Egypt. Pyorrhoea alveolaris has occurred at all periods in Man and has occasionally been described in fossil animals; by contrast dental caries is probably a disease of civilization. Much is therefore known about changes in bone and teeth which are the most durable of animal remains.

Bacteria have, however, been described in very early rocks, in coal and in the petrified faeces of fish and reptiles. They are readily seen in mummified tissues from Egypt. Pott's disease has been observed in a mummy of the 21st dynasty although acid-fast bacilli have not been demonstrated. Syphilis has never been convincingly demonstrated in old world pre-Columbian remains. On the other hand anthracosis, pneumonia and pleurisy of the lungs have been demonstrated in mummies as well as bilharziasis of bladder and kidneys. So also has cholelithiasis and chronic appendicitis; tentative diagnoses of variola, leprosy and poliomyelitis have also been made.

In some of these instances the diagnosis has been made on rather circumstantial evidence, but in the case of the vascular system there is ample direct proof of the existence of disease. Elliot Smith (1912) described tortuous, calcareous temporal arteries in the mummy of Pharaoh Rameses II and extreme calcareous degeneration of the aorta of Pharaoh Merneptah with the formation of large bone-like plaques. A portion of this aorta was submitted to histological examination by Shattock (1909). Shattock made frozen sections and demonstrated long parallel wavy lamellae of elastic tissue with inorganic calcium in the inter-lamella substance; the intima was unaffected. This, however, was not the first description of aortic calcification in a mummy. Czermak (1852), using the simple histological methods then available, described calcification of the aorta in an interesting study of two mummies which he investigated fully at that time.

The collected classical papers of Ruffer (1921) contain much valuable information on vascular disease in Egyptian mummies. He described calcification of

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an atheromatous aorta and left subclavian artery as well as atheroma of the carotid and iliac arteries, the latter with calcification in a mummy of the 18th–20th dynasty. A female mummy of the 21st dynasty showed calcification of the posterior tibial, peroneal and ulnar arteries. Other mummies from this period also showed calcareous aortas and changes in the superficial temporal arteries. Atheroma was also noted in a mummy of the Greek period and calcification of the aorta in a Coptic body of the period A.D. 400–500. Ruffer illustrates these findings by drawings which are difficult to interpret: he classifies the changes as (*a*) coalescing foci of medial calcification producing partial or complete calcification of the vessels, these changes sometimes picking out the sites of origin and (*b*) atheroma with partial calcification and degeneration of the medial coat. It will be noted that these descriptions are difficult to relate to more modern concepts of arterial disease which will be summarized below.

Long (1931) describes an interesting female mummy of the 21st dynasty from Deir-el-Bahri near Thebes. This was that of Teye, a woman of about fifty years of age. Her heart showed calcification of one mitral cusp and thickening, with calcification, of the coronary arteries; there were small fibrous patches in the myocardium while the aorta was the seat of 'nodular arterio-sclerosis'. The capsule of the kidney was thickened, many of the glomeruli were fibrosed and there was sclerosis of the medium-sized arteries. This appears to be an undoubted case of hypertensive arterio-sclerosis.

Shaw (1938) in a valuable paper on the examination of canopic material from a singer of the 18th dynasty (*c.* 1490 B.C.) described the appearances of the pulmonary, hepatic and superior mesenteric arteries. There was no evidence of atheroma but the mesenteric artery showed fibroelastic thickening. Wilson (1927) in a histological study of desiccated remains of Basket Maker Indians of America found no evidence of arterial disease but Williams (1927) described arterio-sclerosis with calcification and calcified thrombus in a Peruvian mummy of about A.D. 700.

At this point it may be said that radiological evidence of unwrapped or even wrapped mummies may reveal evidence of arterial disease. Moodie (1931) found such evidence in a predynastic body. Tortuous sclerosed arteries were seen over scapula, ribs and interosseous region.

It seems unlikely that either the Ancient Egyptians or the Greeks of the Classical period devoted much attention to the cardiovascular system although it is possible that the Greeks observed the coronary arteries. In the process of mummification in Egypt the heart was never intentionally removed from the body. The first descriptions of the coronary arteries came from Drelincourt, Bellini, Thebesius and Lancisi in the seventeenth and eighteenth centuries.

The whole concept of arterial disease has become clarified in recent years and reference may be made to Cappell (1958) for a summary of current views. In brief the following classification is used.

(*a*) Atheroma affects the intimal coat in the deeper layers of which the lamellae degenerate and merge into an accumulation of lipid material. The media is only secondarily affected but the internal elastic lamina may stretch

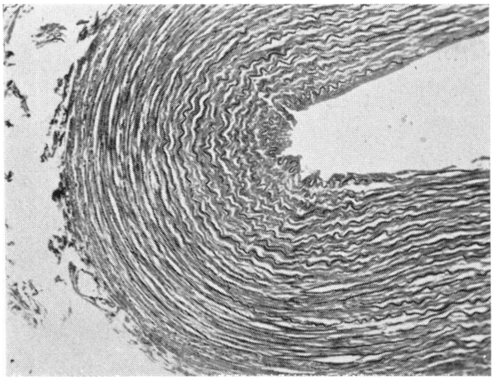

Fig. 1

Carotid artery of a male mummy head. The elastic tissue is well seen and there is fibrous tissue between the laminae. Verhoef's elastica—Van Gieson's fluid. × 160.

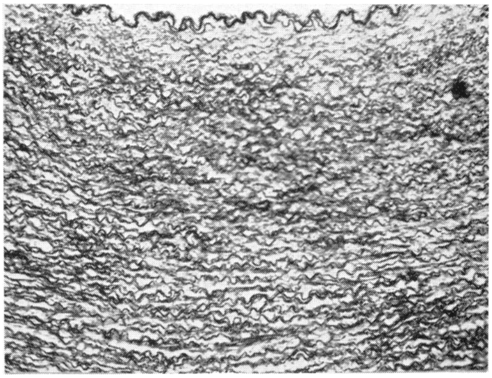

Fig. 2

Carotid artery from a modern autopsy, similarly stained for comparison. Here smooth muscle predominates between the elastic laminae. × 160.

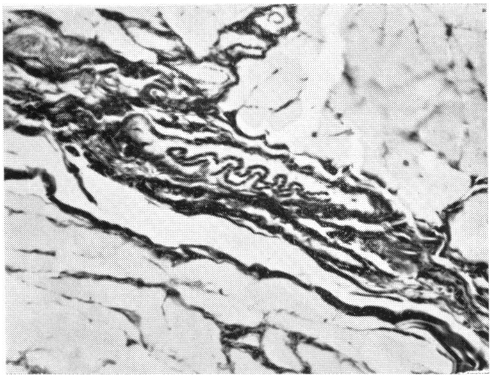

Fig. 3

Small artery of tissues of neck of a male mummy head. Heidenhain's iron—haematoxylin. × 420.

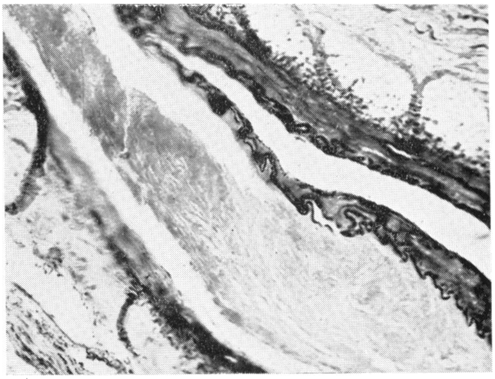

Fig. 4

Tibial artery from an elderly female mummy leg: appearances reminiscent of dissecting aneurysm but the results of splitting of an atheromatous intimal plaque; the amorphous material is sudanophilic lipid. Heidenhain's iron—haematoxylin. × 260.

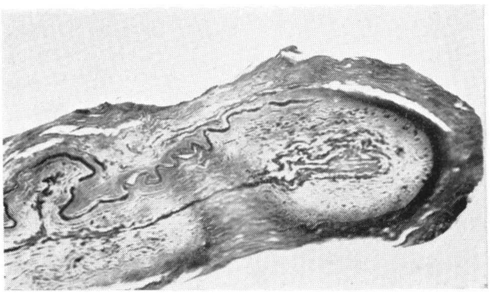

Fig. 5

Sectoral atheromatous intimal thickening at a different level in the same vessel, stained similarly. × 260.

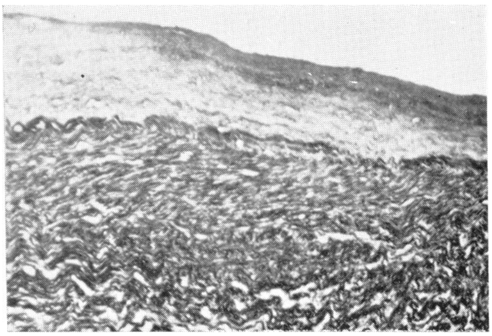

Fig. 6

External carotid of an elderly male mummy head to show sectoral atheromatous thickening of the intima. Heidenhain's iron—haematoxylin. × 160.

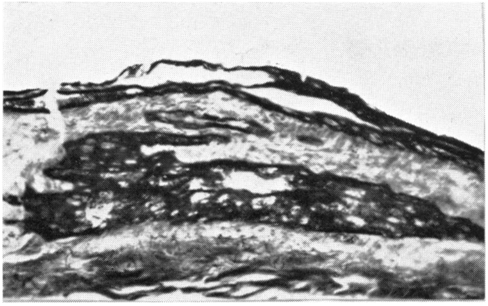

Fig. 7

Calcification of the media of the thyroid artery in a male mummy. Phosphotungstic-acid haematoxylin. × 420.

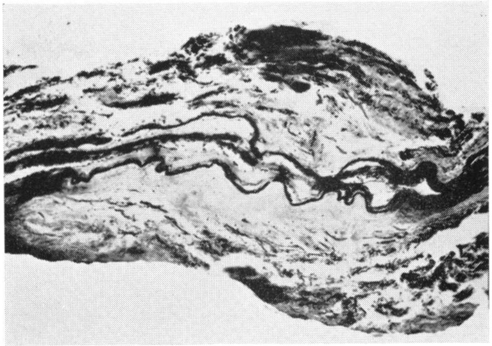

Fig. 8

Early reduplication of internal elastic lamina in another artery from the same case as Figs. 4 and 5. Heidenhain's iron—haematoxylin. × 260.

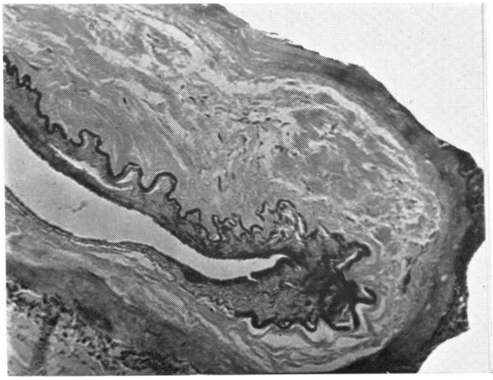

Fig. 9

Reduplication of the internal elastic lamina at another level in the same artery. Heidenhain's iron—haematoxylin. × 260.

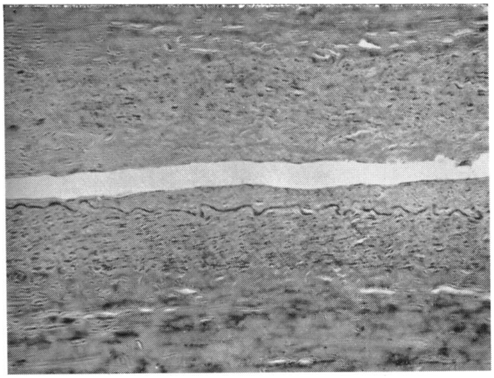

Fig. 10

Mild intimal thickening and medial fibrosis in the occipital artery of the same case as Fig. 6. Heidenhain's iron—haematoxylin. × 260.

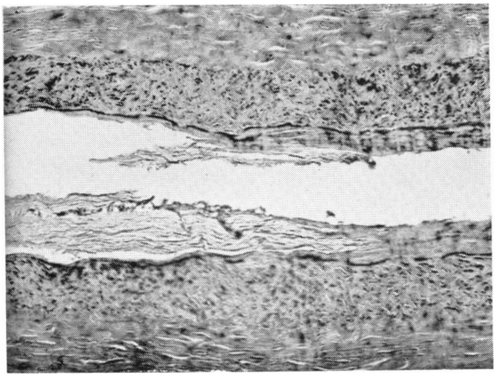

Fig. 11

Rather more marked intimal thickening in mental artery of same case. Phosphotungstic-acid haematoxylin. × 260.

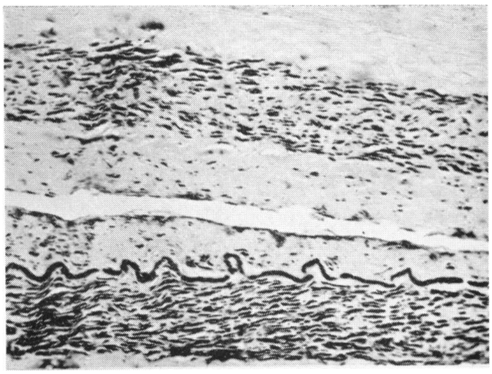

Fig. 12

Large artery of the scalp in the same case showing intimal thickening; the internal elastic lamina is well shown. Heidenhain's iron—haematoxylin. × 260.

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and fragment and the process may extend more deeply. Often there is secondary atrophy of the medial coat. The process is usually a sectoral one.

(*b*) Arterio-sclerosis is commonly associated with hypertension. The arterial wall is thickened and the media at first shows hypertrophy of muscle but later becomes fibrosed. The internal elastic lamina is thickened and may reduplicate into the intima; later the elastic fibres may degenerate and fragment. Especially in smaller vessels there may be intimal proliferation producing concentric thickening.

(*c*) Medial calcification occurs more often in the elderly; transverse rigid bars of calcium form in the mid-zone of the medial coat after hyaline degenerative change in the muscle and connective tissue at this level; there is little or no cellular reaction to this calcium. The processes most frequently affect the iliac and femoral arteries but calcification often occurs in association with atheroma in the lower abdominal aorta.

(*d*) Syphilis of arteries cannot have occurred in antiquity in the Old World since it is now generally accepted that it was a post-Columbian introduction.

(*e*) Thrombo-angeitis obliterans is a relatively uncommon disease occurring in middle life which affects the entire neuro-vascular bundle. Thrombosis is a prominent secondary feature.

The arterial changes described in ancient remains probably fall mainly into the three groups of atheroma, arterio-sclerosis and medial calcification. The latter process is presumably implicated where calcareous change is described in the larger peripheral arteries of the limbs; aortic calcification, on the other hand, is almost invariably associated with severe atheroma. As stated above, however, it is often difficult from the information given by authors to make a precise classification of their cases. The line drawings illustrating the older publications are also difficult to interpret.

It seemed worthwhile to examine the arteries in Egyptian tissues available to me by the methods I have described elsewhere (Sandison, 1955, 1957, 1959), and to attempt to place any degenerative changes seen into definite categories. That the architecture of the arterial wall may be well preserved is seen in Fig. 1. This carotid artery, stained by Verhoef's method and van Gieson's fluid, shows alternating laminae of elastic and connective tissue. Fig. 2 shows the carotid artery of a middle-aged person taken at modern autopsy for comparison. In the mummy artery the smooth muscle has been largely replaced by fibrous tissue, i.e. arterio-sclerosis is present. Similarly small apparently normal peripheral arteries and veins may be seen to be well preserved, e.g. in skeletal muscle and connective tissues, scalp, orbit, etc. (see Fig. 3). The elastica always stains well by specific methods and can usually also be demonstrated in carefully differentiated preparations stained by phosphotungstic-acid haematoxylin and Heidenhain's iron-haematoxylin methods. Care must be taken not to misinterpret certain artefact appearances which may be present. Occasionally some separation of the vessel coats may be noted and in the spaces so formed rather amorphous material may be present (see Fig. 4). The appearances are rather suggestive of dissecting aneurysm but it is too frequently noted for this to be so. What, in fact, has happened is that there has been some shrinkage and splitting of an atheromatous plaque during the process of embalming. Frozen sections stained by Sudan 3 and 4 and by Sudan Black show that the material present in the space is lipid in nature; some of this lipid is birefringent and acicular on examination with polarized light. Some calcium is also present in the depth of the atheromatous plaque; the Nile Blue sulphate method shows no evidence of neutral fat. The amount of lipid present is somewhat diminished after exposure to cold ether. Sudanophil lipid is also present in the associated large nerves of the neurovascular limb bundles. Sections at other levels also showed sectoral atheromatous intimal thickening (see Fig. 5). Sudanophil lipid has also been noted in frozen sections of the occipital artery of an elderly male mummy head; this lipid was present in the intimal coat. In the external carotid artery of the same case, undoubted sectoral intimal thickening was also noted and must be regarded as atheromatous (see Fig. 6). Apart from calcification in an atheromatous plaque some medial calcification was noted in the thyroid artery of another male mummy (see Fig. 7).

Among the undoubted degenerative changes which may also be seen are reduplications of the internal elastic lamina (see Figs. 8 and 9). In the vessels of the calf of the elderly female mummy leg reduplication is readily seen and is associated with fibrosis of the vessel wall. This old woman, whose bones were rather osteoporotic, therefore showed both arterio-sclerosis and atheroma. Mild intimal thickening has also been noted in the smaller arteries of an elderly male associated with medial fibrosis (see Figs. 10, 11 and 12).

It must be emphasized that the changes illustrated above have been noted in a limited amount of mummy tissue available. There is little doubt that histological examination of tissues of mummies at present laid up in museum cellars over the world would lead to the discovery of further and possibly more gross degenerative changes. In particular it would be of great interest to examine the coronary arteries of Egyptian mummies as Long (1931) was fortunate enough to do in one case. In the preparation of mummies the heart was almost invariably left *in situ* and would be available for examination.

Ruffer (1921) pointed out that the presence of degenerative vascular disease in the Ancient Egyptian shows that certain alleged causes may be eliminated, e.g. tobacco was not used, syphilis did not occur, and alcohol was used in unfortified form. Furthermore, the wear and tear of modern life, the habitual use of a heavy meat diet and excessive addiction to athletics can all be largely eliminated, although it is debatable whether life in ancient times was, in fact, less arduous than at present.

Conclusions

The arteries tend to be well preserved in Egyptian mummies and can be examined histologically without great difficulty. There is reason to believe that arterial degenerative disease was not uncommon in Ancient Egypt and useful information might be obtained from the study of mummies at present exhibited as curios or laid up in museum cellars.

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