THE ARTERIAL SUPPLY TO THE ADULT CERVICAL VERTEBRAL BODIES

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The arterial supply to the developing vertebral body has been described by Hanson (1926), Willis (1949) and Ferguson (1950). With the exception of Hanson, who used the bodies of one or two young children, the investigations were made on the thoracic and lumbar vertebrae of foetuses and new-born infants. There were no observations upon the cervical

FIG. 1

Diagram to show segmental artery and its branches.

vertebrae. The observations of these workers were in agreement and may be summarised thus: The main arterial supply to the interior of a developing vertebra enters by the posterior surface. It is derived from an arterial plexus lying deep to the posterior longitudinal ligament extending the length of the spinal canal. The plexus is fed by the thoracic and lumbar segmental branches of the aorta which also supply smaller branches to the antero-lateral surfaces of the bodies.

There is no comparable description in the literature with reference to the fully developed

spine. We therefore investigated this circulation in the cervical spine, using adult vertebrae in place of developing bones. For this purpose we excised the third or fourth to the seventh cervical vertebrae *en bloc* and performed an injection experiment on the fresh specimens.

METHOD

Twelve specimens were investigated, taken from the cadavera of subjects between thirty and sixty years of age. A 50 per cent suspension of Micropaque* in water was used as the injection medium. Each specimen was partly cleared of muscles, and the posterior bone structures (laminae and spinous processes), together with the spinal cord, were removed. It was now necessary to expose the vertebral artery, open it and pass a fine polythene tube into a spinal branch. Micropaque was injected under hand pressure; the flow was observed

FIG. 2

FIG. 3

Figure 2—Arterial anastomosis deep to posterior longitudinal ligament. Decalcified specimen.

Figure 3—Arterial anastomosis deep to posterior longitudinal ligament. Decalcified specimen.

under the dissecting microscope and directed if possible into that branch passing towards the vertebral body. The more successful specimens were radiographed before and after decalcification, and again after sectioning.

ANATOMICAL OBSERVATIONS

The anatomical nature of the specimens made this examination difficult. Our picture of the finer arterial pattern in this region is therefore a composite one, built up from the study of a number of partly successful injections.

In the cervical spine the spinal arterial branches are supplied by the vertebral arteries. Usually single, sometimes paired, these branches enter the spinal canal on the ventral surfaces of the issuing nerve roots, and are larger below than at higher levels. In the intervertebral foramen each spinal vessel divides into three main branches. 1) One branch continues medially

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along the nerve roots to anastomose with the anterior and posterior spinal arteries supplying the spinal cord, and also gives off a recurrent branch passing laterally along the nerve. 2) One or more small vessels supply the laminae and related soft structures (ligamenta flava and muscles). 3) A branch to the dorsal arterial plexus supplies the vertebral body.

FIG. 4

FIG. 5

Figure 4—Median sagittal section showing main nutrient arteries entering posteriorly. Decalcified specimen.
Figure 5—Median sagittal section showing nutrient vessels. Decalcified specimen.

Further small periosteal and muscular branches, which enter extensive muscular and periosteal anastomoses on the surface of the vertebrae, are present and were the main source of leakage during injection. Figure 1 represents diagrammatically the spinal branches and their main divisions.

The branch to the vertebral body divides into two: one branch passes to the front of the body below the pedicles and lateral masses, lying close to or upon the capsule of the lateral synovial joint of Luschka. The other crosses the body deep to the posterior longitudinal ligament and anastomoses with its fellow of the opposite side. From these horizontal anastomoses, ascending and descending branches link with those above and below on either side of the mid-line, forming a freely communicating arterial plexus deep to the posterior longitudinal ligament (Figs. 2 and 3).

The main blood supply to the vertebral body is from this arterial plexus and enters by the posterior surface. The largest single nutrient vessel is in the mid-line and penetrates the body to about one-half its depth (Figs. 4 and 5). The branches of this vessel pass mainly upwards and downwards towards the disc surfaces, the main stem preserving a fairly constant diameter until it terminates abruptly near the centre of the body (Fig. 6). Smaller vessels also penetrate the posterior surface, at least half the interior of the body being supplied from this aspect.

FIG. 6
Enlargement of second vertebra in Figure 5.

The remaining anterior and lateral portions are supplied by the branch passing round on the antero-lateral surface. This supplies one or two lateral branches entering the body below the lateral masses (Figs. 7 and 8) and ends anteriorly in a small mid-line nutrient vessel (Figs. 4 and 5). This pattern of the main nutrient vessels corresponds with that described by Ferguson (1950) in the developing thoracic and lumbar vertebrae.

Comment—The arterial anastomosis deep to the posterior longitudinal ligament is a very free one. Thus the examples shown here were obtained by injection of a single spinal branch and we frequently observed filling of the opposite vertebral artery.

Batson (1942) injected the dorsal vein of the penis in cadavera and live monkeys and demonstrated filling of veins within the pelvic bones, the extradural veins of the spinal canal and veins within the vertebral bodies. He suggested retrograde spread along the veins as the route by which infection and malignant deposits could reach the vertebrae. While

this may explain the spread peculiar to malignant disease of the prostate and other pelvic viscera, the arterial stream should obviously be considered too in the spread of blood-borne disease to the vertebral bodies. Ending in a leash of small vessels with a sudden narrowing

FIG. 7

Radiograph taken from above through whole thickness of vertebral body. Specimen had previously been divided sagittally into three portions.

FIG. 8

Similar to Figure 7, but specimen previously divided sagittally into four portions.

of its calibre, the form of the large dorsal nutrient artery is such that larger emboli would tend to be arrested near the centre of the vertebral body. Smaller emboli, such as bacteria, would pass more readily into the branches, and in this respect it is interesting that tuberculous spondylitis often begins subjacent to the intervertebral discs.

SUMMARY

1. The spinal branches of the vertebral artery were injected with a suspension of barium sulphate and the blood supply of the vertebral bodies of the lower four or five cervical vertebrae investigated radiologically.
2. Beneath the posterior longitudinal ligament there is a free dorsal arterial plexus from which a large branch arises to enter the back of the vertebral body. This vessel terminates abruptly at the centre of the body where numerous, much smaller, branches radiate towards the upper and lower surfaces.
3. The possible significance of the form of the intravertebral arteries is considered in relation to embolic lesion in vertebral bodies.

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