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ACCESSORY SOURCES OF BLOOD SUPPLY TO THE BRAIN OF THE CAT

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The main vessels which maintain the cerebral circulation are the carotid and vertebral arteries, but animals may survive simultaneous ligation of all four of these vessels. Astley Cooper (1836) showed that after such ligatures dogs could regain good condition and develop large anastomotic channels which carried blood rostrally. Similar experiments were reported by Andreyev (1935) and by Evans & Samaan (1936). Hill (1896) ligated these vessels in acute experiments in cats and other animals.

Survival immediately after occlusion of the main vessels must depend on sufficient blood reaching the cerebral circulation to maintain medullary function, and this requires arterial channels to the intracranial (and extracranial) circulation additional to the carotid and vertebral arteries. In the course of investigations into the blood supply of the cat brain (Holmes, Newman & Wolstencroft, 1958) it was noticed that occlusion of the costocervical arteries sometimes caused blood derived from the carotid arteries to extend further caudally than usual in the brain stem. This observation suggested that in some of the animals, at least, these vessels made a significant contribution to the field of supply of the vertebral arteries. The experiments reported in this paper have shown that the costocervical arteries and other vessels arising in the root of the neck can in many animals maintain medullary function after bilateral occlusion of the carotid and vertebral arteries. Some preliminary findings have already been presented (Holmes & Wolstencroft, 1958).

METHODS

Experiments were carried out on 28 adult cats of either sex, weighing between 2 and 5 kg. They were anaesthetized by intravenous injection of sodium pentobarbitone (Nembutal, Abbott Laboratories Ltd., 45 mg/kg body weight). The femoral arterial blood pressure was recorded with a mercury manometer, and in some experiments lingual artery pressure was also recorded with a

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Hürthle membrane manometer connected to a cannula inserted into the central end of the lingual artery, close to its origin from the external carotid. Respiration was recorded by a tambour, with a bypass, connected to the outlet of an expiratory valve attached to a tracheal cannula.

Occlusion of vessels. Loose snares were placed around each common carotid artery (proximal to the dorsal muscular branch unless otherwise stated) and also around the thyrocervical, costocervical and vertebral arteries of each side close to their origin from the subclavian (Fig. 1). In some experiments snares were also placed around the external carotid arteries and the dorsal muscular branches of the common carotids. Bulldog clamps were used for the actual occlusion of the vessels.

Direct observations of the basilar artery. The basilar artery was exposed as previously described (Holmes *et al.* 1958). It was observed under a binocular microscope (10 × magnification) or with the unaided eye during the injection of Evans Blue (0.5% in NaCl 0.9% (w/v)) into the subclavian artery distal to the origin of the vertebral trunk. The injection was made by inserting a No. 19 Record needle through the wall of the artery. In some experiments the dye was injected into the dorsal muscular branch of the common carotid artery by means of a cannula directed away from the main vessel.

Latex injections. After the completion of occlusion experiments on each animal all clamps were removed and the thorax opened. A cannula was inserted into the descending aorta which was tied below this point. The aortic arch was also tied at its origin, and the superior vena cava opened. The vessels of the forepart of the animal were perfused with 300 ml. saline (NaCl 0.9% (w/v)) containing sodium nitrite 20 mg/100 ml. Red latex (rubber latex 60%, Latex Process and Dispersion Co. Ltd.) was then injected at a pressure of 180 mm Hg until small vessels in the mucosa of the mouth and tongue were well filled. The aorta was ligated above the cannula, which was then withdrawn. The animal was immersed in acetic acid 7% (w/v) for 1–2 hr, and then transferred to acidified formalin (40% formalin 10 parts, glacial acetic acid 5 parts, water to 100 parts). Fixation was continued for 3 days or longer. The specimen was finally stored in 50% alcohol, and the vessels of the head and neck later were dissected. A binocular microscope was used in the dissection of the finer branches of the arteries.

RESULTS

Anatomical findings

The latex injection mass filled the arteries of the upper thorax, head and neck, but did not pass through the capillaries into the veins. As a result of the experimental findings reported later, it was apparent that arteries arising in the root of the neck provide accessory sources of blood for the cerebral circulation, and Fig. 1 is a drawing of a typical dissection of the arterial branches in this area.

Costocervical trunk. The distribution of the main branches of this trunk was found to correspond to the description of Reighard & Jennings (1935). The vessel arises from the subclavian artery immediately proximal to the thyrocervical trunk, and gives off almost immediately a superior intercostal branch which supplies the contents of the upper two or more intercostal spaces. A large transverse cervical branch is then given off, which passes over the cranial aspect of the first rib between the 8th cervical and 1st thoracic nerves. In almost all cases the main trunk or its transverse cervical branch gives rise at this point to a vessel which ascends in front of the roots of the brachial plexus, usually lateral to the vertebral artery, and ends in a number of small

branches close to the foramen transversarium of the 6th cervical vertebra. In its course, this 'paravertebral' vessel gives rise to smaller branches, which pass medially along the 7th and 8th cervical nerves. Small branches also travel laterally with these nerves, often lying deeply between them. The most rostral branch of this vessel usually lies between the 6th and 7th nerves and, apparently, supplies muscle and ligaments in this area.

One or more branches from the costocervical trunk pass medially along the 1st thoracic nerve. These branches may arise proximal or distal to the origin of the transverse cervical artery from the main trunk; if distal, they may be

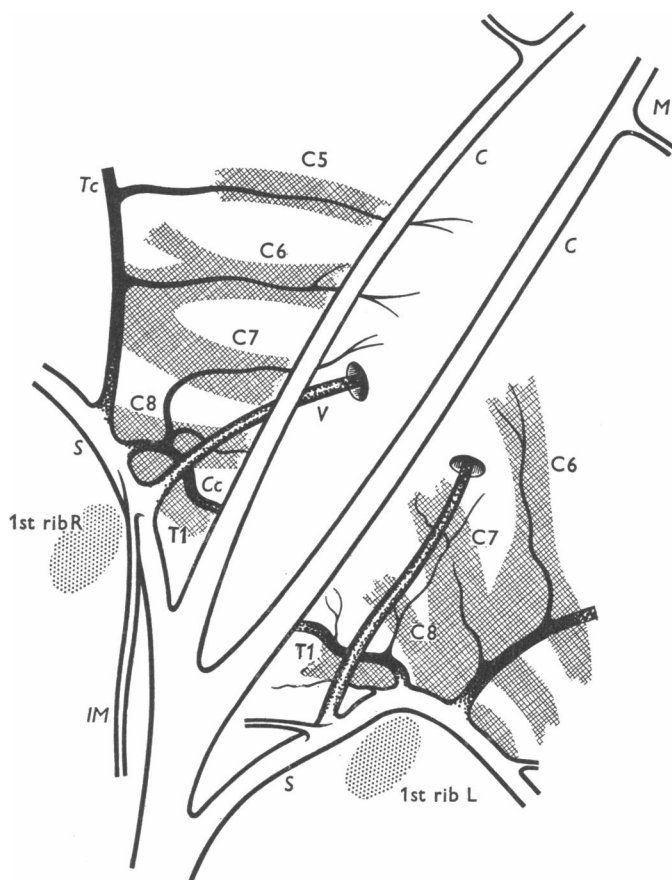


Fig. 1. Drawing of a dissection to show the main arteries in the anterior cervical region, viewed from the left side of the cat. The nerve roots which enter the brachial plexus (C5-T1) are cross-hatched, and branches from costocervical and thyrocervical trunks are shown passing centrally along these nerves. *C*, common carotid artery; *S*, subclavian artery; *Cc*, costocervical trunk; *Tc*, thyrocervical trunk; *V*, vertebral artery, which enters the foramen transversarium in the 6th cervical vertebra; *IM*, internal mammary artery; *M*, dorsal muscular branch of the common carotid.

said to arise from the 'deep cervical' artery, a name given to the main vessel beyond its transverse cervical branch. This deep cervical artery finally passes dorsally between the heads of the 1st and 2nd ribs and gives numerous branches to the cervical muscles.

Thyrocervical trunk. This vessel arises from the subclavian artery slightly lateral to the costocervical trunk, and passes laterally, rostrally and somewhat dorsally, lying on the ventral aspect of the cervical nerves entering the brachial plexus. It gives a branch of variable size to structures in the anterior plane of the neck, and two branches which pass medially, usually along the 6th and 5th cervical nerves, in the same way that branches of costocervical origin pass along the 7th and 8th. These vessels give small branches which run deeply between the nerve roots. In some cases the branch to the 7th cervical nerve may also come from the thyrocervical trunk instead of from the costocervical.

Thus all the nerves entering the brachial plexus are provided with small arteries, which run towards the spinal cord. These vessels are not concerned solely with the supply of nervous tissue, but give fine branches to the soft tissues surrounding the nerves, as well as to ligaments of the vertebral column. In the injected material no major anastomosis could be found between these vessels and the spinal arteries; but small branches were seen to pass along the dorsal nerve roots, and to provide at any rate potential anastomotic channels in this region. After giving off these branches to the dorsal nerve roots, the vessels continue dorsally through the posterior intervertebral foramina, and branch in the dorsal muscular mass. Some may be very closely associated with the vertebral artery as they traverse the vertebralarterial canal, although no actual anastomosis was found.

Vertebral artery. The vertebral artery, in its rostromedial course towards the foramen transversarium of the 6th cervical vertebra, occasionally gives off a small branch which passes medially along one of the lower cervical nerves. In the canal the vessel gives branches to both dorsal and ventral nerve roots. The former, however, are minute, and the main contribution to the spinal plexus appears to pass via the ventral roots.

Contrary to usual descriptions, no dorsal muscular branches of the vertebral arteries were found, except in the suboccipital region. Here the artery gives off a large branch, as it turns dorsally in a groove on the lateral surface of the atlas, which supplies muscles in the upper cervical region. Reighard & Jennings (1935) noted that an anastomosis with the occipital artery might occur here, and such a vessel has been found in some, but not in all dissections. Where demonstrable this anastomosis is between a descending muscular branch of the occipital and one of the smaller suboccipital branches of the vertebral.

Carotid artery. In its course through the neck the common carotid artery gives off a large muscular branch, which passes dorsally into the cervical musculature and branches extensively. One of these divisions may pass

medially along the 3rd cervical nerve, and a smaller branch of this may traverse the vertebralarterial canal, closely applied to the lateral aspect of the vertebral artery, and issue from the posterior intervertebral foramen. It was never possible to demonstrate a direct anastomosis between the latter branch and the vertebral artery.

Intercostal arteries. It does not seem likely that branches of the intercostal arteries can play a major part in the blood supply of the brain. These vessels, however, give rise to small branches which pass medially along the thoracic nerves in the same manner as described in the cervical region, so that intercostal contributions many reach the spinal plexus through this route.

From these anatomical findings it is apparent that after occlusion of the main vessels blood may reach the central nervous system from costocervical, thyrocervical and intercostal arteries by two main routes. The first, and more direct one, is through the branches of these vessels which pass medially along the cervical and thoracic nerve roots, and anastomose with the longitudinal spinal plexus (see Figs. 1, 2). The second is through the various branches of these vessels which ramify in the dorsal cervical musculature. Blood from this field may enter the upper part of the vertebral system through the latter's suboccipital muscular branch (Fig. 2); or may enter the carotid artery by retrograde flow along the dorsal muscular branch. Blood which enters the occipital artery, either by retrograde flow along its muscular branches, or from the upper part of the carotid system, may pass directly to the circle of Willis along the ascending pharyngeal artery (described by Davis & Story, 1943).

As reported below in the experimental section, accessory contributions to the cerebral circulation were adequate to maintain medullary function in most but not all cats after occlusion of both carotid and both vertebral arteries. As in most studies of the vascular system, minor variations in the pattern of arterial branches were noted in individual animals, but these could not account for survival of some animals or medullary failure in others.

Occlusion experiments

Carotid and vertebral arteries. Eighteen animals out of twenty-four (75%) continued to breathe after bilateral carotid and vertebral occlusion (at 5 and 1, Fig. 2). These animals have been called the 'survivors'. Typical responses are shown in Figs. 3 and 4. There was an initial stimulation of respiration, sometimes followed by a period of depression or apnoea; respiration then became steady, the rate and depth being either above or below that found before occlusion. A change from normal respiration to gasping was observed in two animals. Femoral artery blood pressure rose by 50-70 mm Hg.

Six cats ('non-survivors') ceased to breathe within a few seconds of occlusion of these vessels. Blood pressure rose but after about 2 min began to fall. Cardiac failure occurred unless the clamps were removed.

In three 'survivors' an indication of the cephalic arterial pressure was obtained by recording from the central end of one lingual artery with a Hürthle manometer (Fig. 4). After bilateral occlusion of the common carotid artery proximal to the main muscular branch (at 5, Fig. 2), lingual pressure

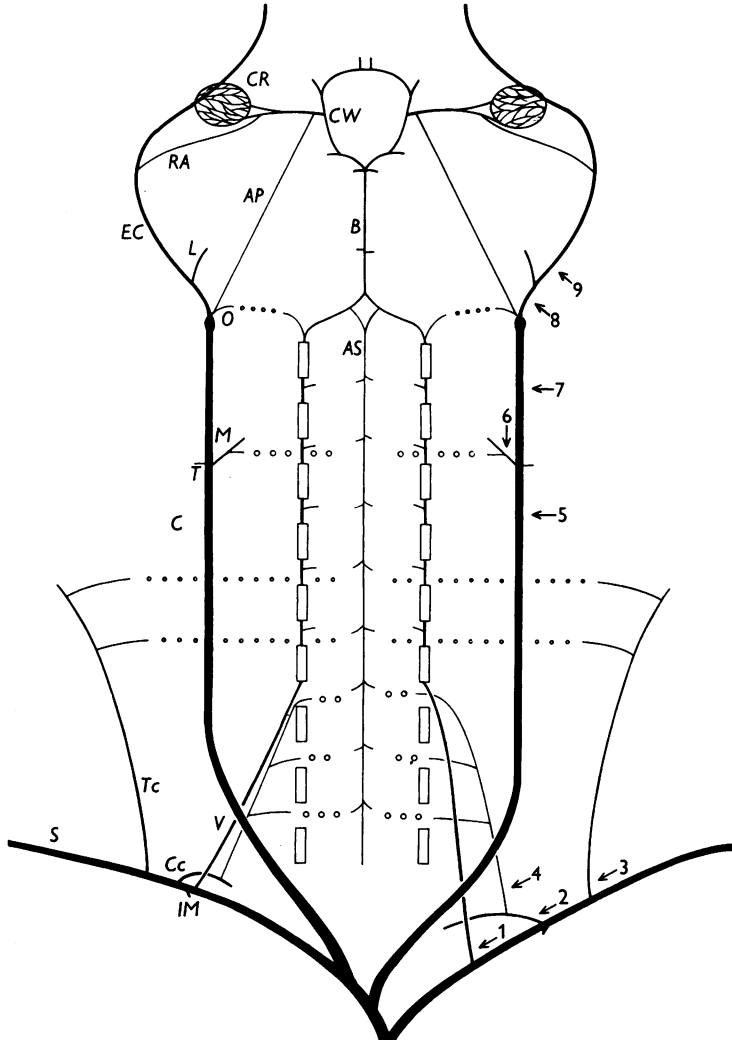


Diagram of the arterial supply to the cat brain. ○ ○ ○ indicates anastomotic channels. (Anastomoses in the dorsal cervical musculature other than occipitovertebral anastomoses are not shown.) Figures 1-9 on the right side of the diagram indicate points of occlusion referred to in the text. Arteries, lettered on the left: AP, ascending pharyngeal; AS, anterior spinal; B, basilar; C, common carotid; Cc, costocervical; CR, carotid rete; CW, circle of Willis; EC, external carotid; IM, internal mammary; L, lingual; M, dorsal muscular branch of common carotid; O, occipital; RA, ramus anastomoticus; S, subclavian; T, thyroid branch of common carotid; Tc, thyrocervical; V, vertebral.

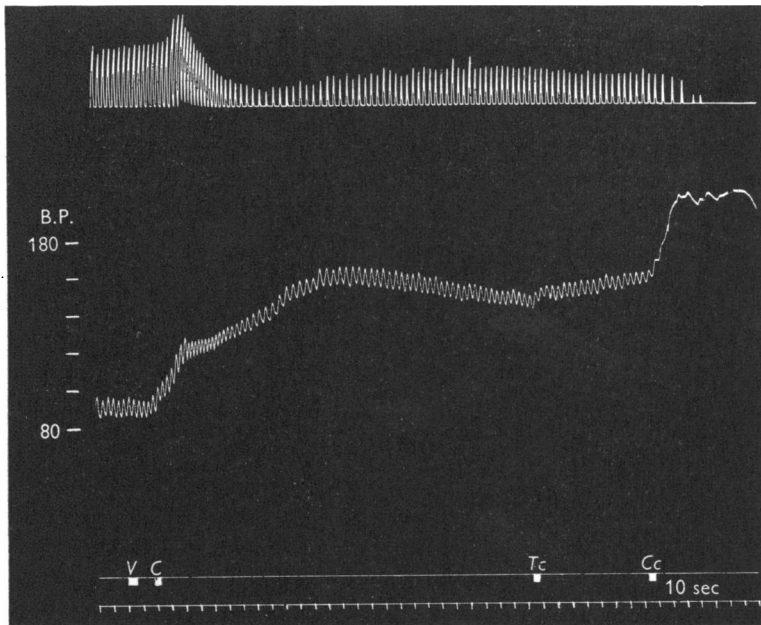


Fig. 3. Cat. Respiration and femoral arterial blood pressure before and during bilateral occlusion of vertebral (V), common carotid (C), thyrocervical (Tc) and costocervical (Cc) arteries.

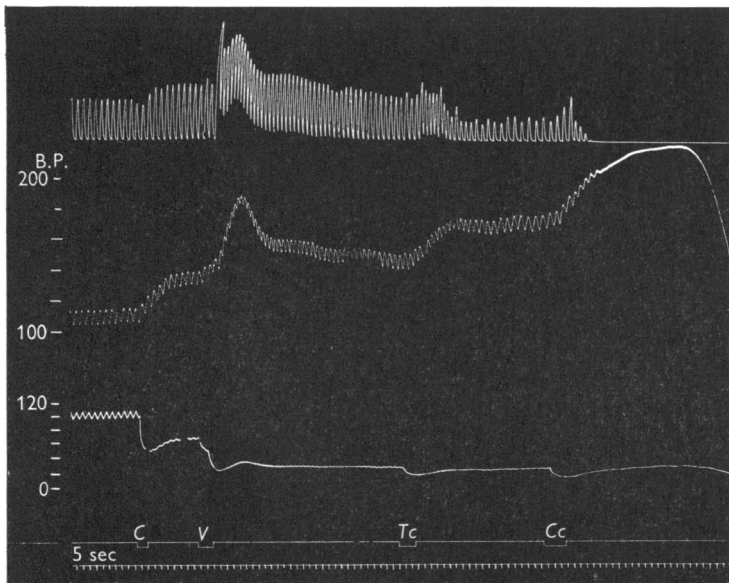


Fig. 4. Cat. Respiration, femoral arterial blood pressure and lingual blood pressure (Hürthle manometer). Bilateral occlusion of same arteries as in previous figure at points indicated.

fell to an average of 38% of its initial value, and then rose again to 55% of this. Bilateral occlusion of the vertebral arteries then produced a fall to an average of 21% of the initial value, followed by a recovery to 25%. This recovery was associated with a rise in systemic pressure, and in one instance in which this did not occur after occluding the vertebral arteries, lingual pressure did not recover. It is interesting to note that Traube-Hering waves were still present in the lingual pressure record after occlusion, although they are not to be seen in the records published by Chungcharoen, Daly, Neil & Schweitzer (1952). Otherwise the changes in lingual pressure reported above are in general agreement with those described by the latter workers.

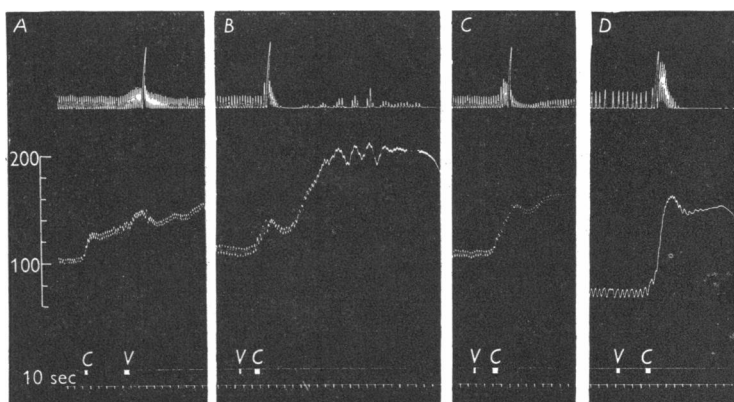


Fig. 5. *Cañ.* Respiration and femoral arterial blood pressure. Bilateral occlusion of common carotid (C) and vertebral (V) arteries. A before and B after 15 mg pentobarbitone intraperitoneally. C $\frac{1}{2}$ hr after B; D after 30 mg pentobarbitone.

In one 'non-survivor' measurements of lingual artery pressure showed that carotid occlusion reduced it to 15% of its initial value, with recovery to 26%. Subsequent vertebral occlusion then reduced it to 13% followed by recovery to 22% and this was associated with a large rise in systemic pressure. These pressures are lower than those described above, suggesting that the anastomotic channels in this animal were smaller than in the 'survivors'.

In two 'survivors' the effect of increasing the depth of anaesthesia was investigated, and a record from one of these animals is shown in Fig. 5. After the response to occlusion had been observed (Fig. 5A), the clamps were removed and a further 15 mg pentobarbitone was injected intraperitoneally. When the occlusion was repeated 10 min later (Fig. 5B), the animal exhibited a brief phase of periodic and subnormal respiration followed by respiratory failure. After half an hour recovery had taken place (Fig. 5C). A further 30 mg pentobarbitone was given, which changed the response to that of a typical 'non-survivor' (Fig. 5D). The second animal gave similar results.

Thyrocervical and costocervical arteries. The animals in which respiration persisted provided sensitive preparations in which any further reduction in the blood supply by occlusion of other vessels could be readily detected. Unless otherwise mentioned, all the experiments described in this and the following section were made on these 'survivors'.

Subsequent occlusion of the thyrocervical arteries (at 3, Fig. 2) was followed by depression of respiration and a rise of blood pressure, although the size of this effect varied from one animal to another (Figs. 3, 4). Occlusion of the costocervical arteries (at 2, Fig. 2) after carotid and vertebral occlusion had a similar but more constant effect. In one animal the branch of the left costocervical artery that ascends close to the vertebral artery (at 4, Fig. 2) was separately occluded, producing depression of respiration. When both thyrocervical and both costocervical arteries were occluded respiration failed in most animals, and an initial rise of blood pressure was followed by a profound fall (Figs. 3, 4). In three cats respiration continued after all these vessels had been occluded.

Measurements of lingual pressure after carotid and vertebral occlusion gave an average value of 27 mm Hg. The additional occlusion of the thyrocervical arteries resulted in a reduction of lingual pressure by an average of 10 mm Hg, which was then followed by a return to its previous value as the systemic pressure rose. Occlusion of the costocervical arteries then reduced lingual pressure by an average of 14 mm Hg, which was again followed by recovery (Fig. 4).

The above experiments demonstrated that when the carotid and vertebral arteries had been occluded, the thyrocervical and costocervical arteries contributed to medullary blood supply. They also showed that when these four vessels were occluded bilaterally other arteries made a contribution to cephalic arterial pressure which was sufficient to maintain medullary function in three animals (13%). This contribution possibly came from the intercostal arteries, via the longitudinal spinal plexus.

In one 'non-survivor' occlusion of the costocervical (but not the thyrocervical) arteries reduced lingual pressure after bilateral carotid and vertebral occlusion. This showed that anastomotic channels via this artery were patent in this animal, although the blood flow was insufficient to maintain medullary function.

Dorsal muscular branches of the common carotid arteries. After occlusion of the vertebral arteries and the common carotid arteries proximal to the dorsal muscular branches (i.e. at 1 and 5, Fig. 2), blood flowed in a retrograde direction through these branches, into the common carotids and along the external carotid arteries to contribute to the maintenance of medullary blood supply. This was evident from the following experiments: (i) The occlusion of the dorsal muscular branches (at 6, Fig. 2) on one or both sides led to a

further fall of lingual pressure, followed by depression or cessation of breathing (Fig. 6*A, C*). Occlusion of the thyroid branches had no such effect. (ii) Occlusion of one external carotid proximal to its lingual branch (at 8, Fig. 2) produced a fall of lingual pressure and depression of breathing (Fig. 6*C*). (iii) Occlusion of one external carotid distal to its lingual branch (at 9, Fig. 2) produced a rise of lingual pressure and depression of breathing (Fig. 6*B*).

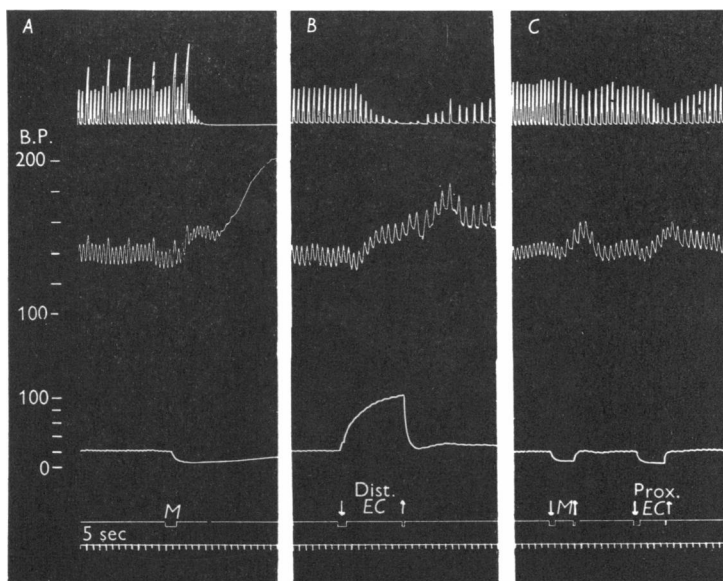


Fig. 6. Cat. Respiration, femoral and lingual arterial blood pressures. Before these recordings the vertebral arteries had been occluded and also the common carotid arteries, proximal to their dorsal muscular branches. *A*: *M*, bilateral occlusion of the dorsal muscular branches of the common carotids. *B*: *EC*, unilateral occlusion of the external carotid distal to the lingual artery used for recording; arrows indicate beginning and end of occlusion. *C*: *EC*, unilateral occlusion of the external carotid just proximal to the lingual artery used for recording; *M*, unilateral occlusion of the dorsal muscular branch of the carotid on the same side; arrows as before.

In Fig. 6*C* the fall of lingual pressure produced by occlusion of one muscular branch and by occlusion of the external carotid just proximal to the lingual branch on the same side were approximately equal, indicating that most of the blood flowing into the external carotid was reaching it via the muscular branch. When the flow of blood was interrupted by occlusion of this branch subsequent occlusion of the external carotid artery proximal to the lingual branch (at 8, Fig. 2) on the same side produced a slight further fall in lingual pressure (about 2 mm Hg). This could have been due to exclusion of blood entering by a retrograde flow along the occipital artery.

When the common carotid arteries were occluded distal to the muscular

branches (at 7, Fig. 2) the subsequent occlusion of these branches (at 6, Fig. 2) again reduced lingual pressure and produced depression of respiration. It is evident that under these conditions blood was flowing from the common carotid arteries through the muscular branches and via anastomoses previously described to contribute to medullary blood supply.

Direct observations

Dye injections. In four cats the basilar artery was observed during the injection of Evans Blue into the left subclavian artery distal to the origin of the vertebral artery but proximal to the costocervical artery. Dye entered the costocervical and thyrocervical arteries but none was seen in the basilar artery. These results contrast with the observation of dye in the basilar artery when it was injected into the subclavian proximal to the vertebral artery (Holmes *et al.* 1958).

The basilar artery was also observed in four cats while dye was injected through a cannula inserted into the peripheral end of the muscular branch of one common carotid artery. In two of these animals dye was seen in the basilar artery immediately after the injection.

Latex injections. Certain observations were made during injection of latex after the death of the animal. In one animal the common carotid arteries were ligated before the injection both above and below their dorsal muscular branches. In addition the external carotid vessels were tied above and below the origin of the occipital artery, and the costocervical, thyrocervical and internal mammary arteries were also ligated. The vertebral vessels were left patent, and the common and external carotid arteries were opened between the ligatures to allow fluid to escape. During the injection latex was observed to flow along the dorsal muscular branches into the common carotids. It also entered the occipital artery of one side, and appeared in both thyrocervical and both costocervical vessels distal to the ligatures. This provided further evidence for the existence of anastomoses between the vertebral arteries and the muscular branches of the carotids, and also with the occipital, costocervical and thyrocervical arteries.

DISCUSSION

The experiments described above confirm that in the majority of cats subjected to bilateral occlusion of the carotid and vertebral arteries sufficient blood may reach medullary neurones to maintain function for at least a limited period. This fact had been shown previously by a number of authors, including Hill (1896) who found that 60% of his cats survived such a ligation. Dogs apparently withstand this procedure more readily (Astley Cooper, 1836; Evans & Samaan, 1936). Monkeys survive; but rabbits usually succumb (Hill, 1896). The present study has been concerned only with the 'acute' state, and the adequacy of anastomotic channels to prevent immediate loss of medullary function. The anatomical studies also have been concerned only with the

demonstration of anastomoses patent in such 'acute' preparations. The great enlargement which such channels may undergo if the animals are allowed to survive occlusion of the vessels for some months was strikingly demonstrated by Astley Cooper (1836).

The present experiments demonstrate a number of accessory routes by which blood can reach the brain. If the carotid and vertebral arteries are occluded, the main sources of blood will be from the costocervical and thyrocervical arteries. There may also be a contribution from other vessels which connect with the longitudinal spinal plexus. The dorsal muscular branches of the common carotid arteries provide another anastomotic channel in which the direction of flow will depend on the point of occlusion of the carotid arteries. The level of the occlusion will be of first importance in determining which anastomotic channels (muscular and spinal) can be utilized. The most effective method of reduction of the blood supply to the brain would probably be that of ligation at several levels, e.g. ligation of the vertebrales near their origin from the subclavian arteries and rostral to their junction with the anterior spinal artery; ligation of the carotid arteries above and below the muscular branches, and ligation of the external carotid arteries.

It is clear that, in any experiments involving occlusion of arteries in this region, the point of occlusion must be accurately known and possible anastomotic channels considered. These anastomoses must also be considered in relation to the technique of anaemic decerebration, introduced by Pollock & Davis (1923). In this procedure the basilar artery is ligated at the desired level, and the common carotid arteries clamped. Constantin & Wang (1958) have pointed out that this procedure may not lead to complete diencephalic anaemia in cats. They found that hypothalamic responses to electrical stimulation could persist for at least 2 hr after decerebration by this method, but that they disappeared if the cervical musculature had been ligated previously. They attributed this finding to the presence of an occipitovertebral anastomosis which we have found inconstantly in the cat. Jewell (1952) considers that such a connexion is always present in the dog, and found that carotid blood may reach the basilar stream by this route (Jewell & Verney, 1957). Another possible channel along which blood could reach the rostral brain stem under these conditions would be via the muscular branches of the carotid, as described above, provided that the carotid arteries had been clamped proximal to these. The point of occlusion is not specified by Constantin & Wang (1958), nor in the original description by Pollock & Davis (1923). However, a later paper by Pollock & Davis (1930) states 'it is important to ligate the common carotid trunk and its external and internal branches, because in some animals an anastomosis is present between the terminal branches of the carotid and the vessels of the neck'. This was written before Davis & Story (1943) had noted that the internal carotid is not usually patent in adult cats.

To remove all extracranial sources of blood to the circle of Willis after tying the basilar artery, each common carotid must be clamped above its muscular branch (probably the largest single anastomotic channel); the external carotids should be occluded above the occipital artery to prevent blood passing via a vertebral-occipital anastomosis; and the small ascending pharyngeal arteries to the circle of Willis must also be ligated.

It is difficult to assess the role played by these various vessels in the cerebral blood supply of the intact animal. Any experimental approach must inevitably change the haemodynamic equilibrium to some extent. It was found that occlusion of the costocervical trunk resulted in a more caudal distribution of carotid blood in the brain stem of some cats (Holmes *et al.* 1958). Dye injected so as to enter subclavian branches other than the vertebral artery could not be detected in the basilar artery, but could be found in the cervical cord (Holmes & Wolstencroft, unpublished observations). It appears that costocervical (and probably thyrocervical) blood contributes to basilar artery pressure (Holmes *et al.* 1958), but probably not to basilar flow under normal conditions. Ligation of thyrocervical and costocervical trunks could thus reduce the arterial pressure in the cervical part of the longitudinal spinal arterial channels, and hence create a tendency for vertebral and carotid blood to flow to more caudal levels than usual.

If the present series of experiments is compared with that of Hill (1896), the number of cats surviving carotid and vertebral occlusion was 75 and 60%, respectively. Anatomically no difference could be detected between the 'survivors' and 'non-survivors' of the present series, and the costocervical arteries were found to contribute to lingual pressure in both groups of animals. However, the lingual pressure after occlusion of the carotid and vertebral arteries was lower in a 'non-survivor' than in the 'survivors'. This suggests that the size of anastomotic channels available may be a factor governing survival of the medulla in acute experiments, and that failure of the medulla may be a direct consequence of blood flow falling below a critical level. Depth of anaesthesia is another important factor.

Although it has not been the purpose of these experiments to investigate the critical pressure below which respiratory failure occurs, the results are in agreement with those of Roberts (1924). He found that respiration was paralysed in rabbits when the pressure measured from the central end of one carotid artery fell to a value between 6 and 18 mm Hg. In the present experiments respiration has continued on several occasions when the lingual pressure was between 5 and 10 mm Hg. It is possible that medullary failure under these conditions was due to closure of blood vessels below a critical pressure (Burton, 1951). Measurements of the 'critical closing pressure' for the rabbit's ear and hind limb by Nichol, Girling, Jerrard, Claxton & Burton (1951) gave a value of 5 mm Hg in the absence of vasomotor tone. Carlyle & Grayson (1956)

found that cerebral blood flow fell to zero when the blood pressure was 20 mm Hg but the present experiments suggest that medullary flow may continue when pressure is in the range 5–10 mm Hg. Further information on basilar artery pressures and flow would seem desirable before it can be decided whether reduction in flow or complete closure is the cause of medullary failure under these conditions.

SUMMARY

1. Respiration continued after occlusion of the common carotid and vertebral arteries in eighteen out of twenty-four anaesthetized cats.

2. Subsequent occlusion of the thyrocervical and costocervical trunks was followed by respiratory failure in all except three animals.

3. Records of pressure in the lingual artery and of respiration before and after various occlusive procedures showed that blood could also reach the medulla along an anastomotic route which included the dorsal muscular branches of the common carotid arteries, and that the direction of flow in these vessels varied with the sites of occlusion of the main trunks.

4. Dissections made after arterial injections of latex showed that branches from the costocervical and thyrocervical trunks pass medially along all the nerves entering the brachial plexus and form potential anastomoses with the spinal arterial plexus. Branches from the vertebral arteries also pass centrally along dorsal and ventral nerve roots towards the spinal plexus.

5. A second anastomotic field lies in the dorsal cervical musculature, and includes branches of the costocervical and thyrocervical trunks, dorsal muscular branches of the common carotids, suboccipital branches of the vertebrales, and the occipital arteries.

6. Direct observations showed that dye injected into the costocervical and thyrocervical trunks does not normally reach the basilar artery, but that dye injected into the dorsal muscular branches of the common carotids may do so.

7. The technique of anaemic decerebration is discussed in relation to the present findings, and a procedure suggested for the effective limitation of the blood supply to the circle of Willis.

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