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Update in Neurosciences

The first case of traumatic internal carotid arterial dissection? Verneuil's case report from 1872

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ABSTRACT

Dissecting aneurysms of the internal carotid artery were considered as very rare disorders before the seventies. Undiagnosed carotid-artery dissections, however, may have gone hidden behind earlier reports of delayed "apoplexy" due to "traumatic carotid thrombosis". Here, we present a case report of delayed stroke after trauma, published by Aristide Verneuil in 1872 in the *Bulletin de l'Académie de Médecine* and cited under the heading of vascular rupture and dissecting aneurysm by Heinrich Quincke in 1876. Verneuil's case report represents, to our knowledge, the first detailed clinical description of a patient with a traumatic carotid dissection confirmed at autopsy. The author highlighted the diagnostic challenges of this case, head injury followed by delayed hemiplegia suggesting an intra-cranial bleeding.

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1. Historical context: the concept of aortic dissection

The French physician, René Laennec (1781–1826), introduced the notion of dissecting aneurysm ("*anévrisme disséquant*") in his autopsy report of the late Jean Millet, a 67-year-old merchant admitted to the Necker Hospital in Paris on April 22nd 1817 [1]:

"The aortic arch – dilated up to the size of an apple – was incrusted with bony plaques. About two thumbs from its origin, the inside of the descending aorta showed a transverse split across two-thirds of its contour, affecting only the inner and fibrous layer (i.e. the tunica intima and tunica media). The borders of that split were thin and irregular and appeared locally torn. The cellular layer (i.e. the adventitia) was healthy and detached from the medial layer below that tear until the origin of the common iliac arteries, so that the lumen of the aorta seemed divided by a membrane... This detachment formed a kind of elongated sac with deeply red-violet colored walls..."

Soon after its first description, dissection was recognized as an important aortic pathology by contemporaries. Several historical reports of aortic aneurysms, moreover, were reinterpreted as dissecting aneurysms [2]. The aorta was recognized as a common site of aneurysms only in the second half of 18th century, while superficial aneurysms–described as "soft pulsating tumors containing blood" – and their treatment were the main concerns of earlier authors. The description of aortic aneurysms by pathologists of the early

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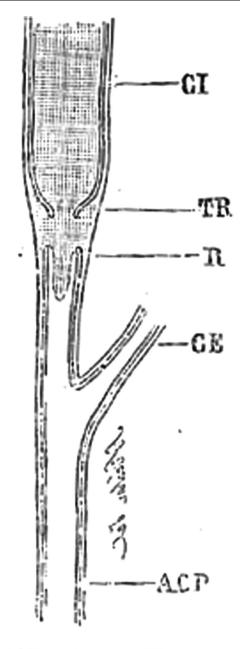
19th century elicited a shift in the understanding of this vascular disease by considering the aneurysm of the aorta as paradigm of aneurysms of the whole arterial tree. The current study documents the subsequent generalization of the concept of dissection – from an exclusively aortic pathology into a pathology that may affect the whole arterial system, including the brain supplying arteries.

2. The case report by Aristide Verneuil

Verneuil's article [3] is entitled by the following key words: multiple contusions, violent delirium, right sided hemiplegia, signs of cerebral compression; death after five days. Complete rupture of the inner coats of the left cervical internal carotid artery, vessel occlusion at the damaged site by a clot that extends until the ultimate branches of the medial cerebral artery: softening of nearly the complete medial brain lobe.

A 46-year-old man, working at the Gare du Nord railway station in Paris, was admitted to the nearby Lariboisière Hospital in the morning of December 14th, 1871, after being caught under a railway carriage. Verneuil draws attention to the diagnostic challenges of the case: "We report a traumatic injury that was quite minor with regard to the severity of the initial disorders, but appeared fatal rapidly thereafter - with all classical symptoms of another lesion that didn't exist. The diagnostic failure was complete and unfortunately nearly inevitable because of the current state of our knowledge and the rarity of the cause. So I admitted rupture of a small vessel at the right side lower frontal lobe, slow effusion that initially irritated the superficial hemispheric gray matter and later compressed that hemisphere as its volume increased. This would explain the delirium of the first day and the subsequent hemiplegia."

Autopsy, however, allowed rectification of Verneuil's initial misdiagnosis: "The skull was cautiously opened with a saw. The skull bone was completely intact, no trace of fracture, no remnants of blood effusion, insignificant subcutaneous ecchymosis at the minor frontal contusion that was observed at admission. Meninges hardly filled; cerebrospinal fluid of normal proportion... The brain appeared at first glance free of any damage. Infinitely surprised by this negative result, I took a look at the basis of the skull, in the hope of finding some injury, and there I was lucky. I noted that the left carotid artery - along the Turkish saddle, just where it was cut to remove the brain - was filled with a red clot, like a vessel injected with anatomical wax. On subsequent inspection I found the medial cerebral artery also filled with coagulum along its whole length until the main branches. The elongated clot occluded the vessel lumen completely, without being tightly attached to the vessel wall. The clot was firm to the touch and reddish of color and doubtless several days old. Now it was crucial to find out where the coagulum ended downwards in the carotid artery. So we followed it from top to bottom, first through the carotid canal, whose wall coats were intact, than until the common carotid artery. There the original injury was easily detected. At two centimeters above its origin, the internal carotid artery showed a sudden widening that extended until its entry in the carotid canal. The artery was almost of double volume and resisted against



 ACP, artère carotide primitive; CE, carotide externe; CI, carotide interne; R, ropture des deux tuniques internes; TR, ces tuniques refoulées vers l'axe du vaisseau.

Fig. 1 – Schematic drawing illustrated the observed pathology of Verneuil.

compression. A longitudinal incision, carefully made, revealed at the position where the arterial volume increased a circular tear of the intimal and medial layers with clear borders." A schematic drawing illustrated the observed pathology (Fig. 1).

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Verneuil once more underlined his initial diagnostic failure by comparing this case with another, very similar patient: "I had been so much obsessed by the idea of cerebral compression due to effusion that I did not bring this case in connection with another observation that I made only a few months before and that showed perfect similarity, at least on the level of pathology, symptoms and outcome. It was a ligature of the common carotid artery that became rapidly fatal. At autopsy I also found a thrombosis of the whole internal carotid and medial cerebral arteries, with softening of extended central parts of the medial lobe."

In a concluding section, Verneuil's report discussed the possible mechanism that caused the observed arterial damage and the resulting outcome: in this final section – as in the whole report – the absence of the notion of "dissecting aneurysm" is particularly striking. "Usually, violence upon large arteries causes aneurysms that – after delay – are called spontaneous. The outcome of the violence is probably related to the size of the injury. A partial tear of the arterial circumference will finally lead to arteriectasia, while a complete circumferential tear will induce an occlusion, like it is almost an absolute rule after arterial ligature."

3. Reception history: carotid artery thrombosis

An early review of "traumatic thrombosis of the internal carotid artery", published in 1959 [4], summarized data of sixteen patients: "The youngest patient was 16 and the oldest 45 years of age, while 10 were aged 20 to 30 years." The earliest cases were from the 1930s - Verneuil's case was not included. Regarding the origin of thrombotic obstruction, the author concluded: "There seem two possible sites of obstruction. Of 10 cases with adequate necropsy reports, nine showed damage to the intima and usually the media of the artery in the 2 to 3 cm above the bifurcation of the common carotid with corresponding thrombus formation, while in one extravasation of blood into the carotid sheath at this level was the most prominent feature apart from the thrombus itself. In the six survivors, where there is only arteriographic evidence, the block was near the origin of the internal carotid in four and high in its course in two, where it was described respectively as at the base of the skull and just distal to the origin of the posterior communicating artery." For a modern reader, it might be interesting that these cases of "traumatic thrombosis of the internal carotid artery" were presented in this review without reference to the concept of "dissecting aneurysm". However, some of the original papers mention the diagnosis of dissection [5]: on the morning of August 19, 1942, a signalman aged 31 was thrown to the ground when a rope hanging from a lorry twisted itself about his neck and then unwound itself without dragging him along. The patient sustained a slight bruise of the tissues over the sterno-mastoid muscle, but remained quite well for the ensuing twenty-four hours. At this time, he became comatose and died within a few hours. Autopsy disclosed an extracranial dissecting aneurysm of the internal carotid artery, with complete obliteration of its lumen by the displaced intima and internal elastic lamella. A fresh thrombus was found above this point. According to the

authors, "the mechanism of a dissecting aneurysm is believed to be a rupturing of the inner part of the media, followed by giving way of the intima, thus allowing blood from the vessel to spread in the substance of the media, splitting it up into two layers." They conclude: "the interest of the case lies in the problems of differential diagnosis and in the pathological findings... The presence of a head injury, with a lucid interval following a short amnesia, and subsequent development of hemiplegia, naturally suggested an intracranial hemorrhage." Obviously, this later view was anticipated by Verneuil some seventy years before.

4. The emerging concept of carotid artery dissection

According to C. Miller Fisher in 1971, "the sparse literature on spontaneous dissection of the internal carotid artery revealed only 9 clinical cases, 7 of which had been fatal" [6]. A similar rarity of cases noted the historical study by de Bray and Baumgartner, "Dissection of the carotid arteries was not documented until the mid-1900s. Dratz and Woodhall published the first description of a patient with traumatic dissection of the internal carotid artery in 1947 [7]. The first clear case of a spontaneous dissecting aneurysm of the internal carotid artery was described by Anderson and Schechter in 1959" [8]. Our current analysis revealed that the literature on carotid dissection traces much further back in history, as reports of traumatic carotid thrombosis may present pathologies that modern medicine would diagnose as carotid dissections. Verneuil's clinical and pathological report [3] is an early and excellent example of such a report.

Compared to these occasional historical reports, Verneuil's publication is outstanding for the following reasons: 1) for the first time, carotid disease was identified as a cause of ischemic stroke; 2) the report described and illustrated the vascular injury of a carotid artery dissection in detail; 3) Verneuil avoided the diagnosis of "dissecting aneurysm", by arguing that arteriectasia (i.e. local arterial widening – in other words: dissecting aneurysm) is caused by a local tear in the inner arterial layers. The observed carotid transection (rupture of the complete circumference of the inner wall layers), however, was not supposed to cause a dissecting aneurysm. We suspect that Verneuil avoided the notion of "dissecting aneurysm" for this reason. It was Heinrich Quincke, who cited the case among other patients with "dissecting aneurysm and vascular rupture" in 1876 [8].

The rarity of carotid dilation due to dissection may have been another "obstacle" [9] to transpose the concept of dissecting aneurysm from the aorta onto the cervical arteries. The dichotomization of arterial pathologies into either dilative or obstructive was outlined by Michael deBakey (1908–2008) in a historical review [10]: "Most vascular diseases are of arteriosclerotic or atherosclerotic origin... In general, most aortic and arterial diseases may be classified into two major categories: occlusive and aneurysmal lesions." Cervical artery dissection does not fit well within this paradigmatic view on arterial diseases. First, dissecting aneurysms of the carotid artery do not present as dilative, but rather as obstructive lesions. Second, though typically presenting as occlusive

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4

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REVUE NEUROLOGIQUE XXX (2020) XXX-XXX

disease, carotid dissection usually occurs in young patients without significant arteriosclerosis [10]. Typical vascular risk factors do not play an important role in the etiology of carotid artery dissection. Only after the emergence of the concept of "large artery occlusion" as a common stroke etiology (by the work of C. Miller Fisher in the 1960s), carotid artery dissection could be identified as a rare subtype of large artery occlusive disease, albeit non-atherosclerotic, non-inflammatory, and preferentially occurring in young patients.

5. Conclusion

Verneuil's report is an early milestone in the history of cervical artery dissection, despite the fact that the notion of "dissecting aneurysm" is absent from the report. Although Verneuil was familiar with the concepts of arteriectasia and aneurysm, he may have avoided the diagnosis of dissecting aneurysm, which probably reflects the fact that the pathology of aortic dissection, characterized by a double lumen and an intimal tear, cannot be one-to-one transposed to the cervical or the intracranial arteries. We see a similar reluctance to describe thrombotic carotid injury due to blunt trauma as "dissection" until the 1980s [11,12]. The modern concept of carotid artery dissection describes a heterogeneous cluster of pathologies, including purely intramural hematoma [13], double lumen signs [14] and different types of intimal lesions [15], which is also reflected by a certain confusion of terminology (dissection/dissecting aneurysm/pseudo-aneurysm) even in recent publications [16]. Hence, Verneuil's difficulty to decide on the plain diagnosis of "dissecting aneurysm" in this case of fatal stroke due to traumatic carotid thrombosis seems to point to a certain fuzziness of the concept of dissection, when generalized as an arterial disease that may affect not only the aorta, but also the carotid, renal, coronary, or intracranial arteries.

Disclosure of interest

The authors declare that they have no competing interest.

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