The Carotid Siphon: A Historic Radiographic Sign, Not an Anatomic Classification

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Key words
- Carotid siphon
- Classification
- Segments of the internal carotid artery

Abbreviations and Acronyms
ICA: Internal carotid artery
S.C.: Siphon carotidien (carotid siphon)

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BACKGROUND: **After the term *carotid siphon* was introduced by Moniz in 1927 to describe the radiographic appearance of the intracranial internal carotid artery (ICA), the concept gained popularity in decades following in both the anatomic and the medical literature. However, as conflicting definitions persist in the delineation of proximal and distal sites, does the term *carotid siphon* provide the precision needed for current anatomic and clinical studies?**

METHODS: **A PubMed search of "carotid siphon" detected >400 articles from the anatomic and medical literature during the past 6 decades. Moniz's text and figures in his original *Lancet* article and a compilation of other seminal historical articles and references were reviewed to trace the use of the term *carotid siphon* during this period.**

RESULTS: **Viewing the radiographic silhouette of a normal ICA, Moniz defined the carotid siphon as the series of bends and curves; an additional curvature was identified as a *double siphon*. Throughout Moniz's works, in text and figures, the boundaries of the carotid siphon were never delineated. Authors who followed attempted to correlate his original description of this two-dimensional radiographic projection with anatomic documentation.**

CONCLUSIONS: **Tracing the origin and usage of the term *carotid siphon* during 6 decades in the medical literature shows continued discrepancy rather than consensus. The term *carotid siphon* is historically relevant but can now be supplanted by definitive ICA classification systems, which continue to evolve in contemporary medical and anatomic communications.**

INTRODUCTION

When the term *carotid siphon* was first introduced by Moniz in 1927, he was describing the radiographic appearance of the intracranial internal carotid artery (ICA) (2). Visualized by this emerging technology, Moniz's account of the carotid siphon was based solely on cerebral angiographic findings; its precise anatomic boundaries—specifically its origin and termination—were never, nor likely intended to be, defined. Yet the term gained popularity, as evidenced by >400 articles published during the subsequent 6 decades in both the anatomic and the medical literature. Numerous clinical investigations attempted to delineate the proximal and distal sites of the carotid siphon. However, conflicting definitions continue, and the term *carotid siphon* remains as vague as its initial appearance on Moniz's early radiographic images (4,7-9, 11, 14, 15, 19).

Contrasting with the ambiguity of the carotid siphon, several precise ICA classification systems are in use or currently proposed. In this article, we reexamine the origin of the term *carotid siphon* in Moniz's original work, follow its history as applied by other investigators, and define the changes in its meaning and usefulness over time. In exploring the origin of this term, we raise the following question: Does the term *carotid siphon* provide the clarity and precision necessary in current anatomic and clinical studies?

METHODS

Searching PubMed of the National Library of Medicine database for "carotid siphon," we identified its use in >400 articles from the anatomic and medical literature during the past 6 decades. We reviewed Moniz's text and figures in his original article in *Lancet* and a compilation of his articles available in The Winkler Center for the History of Health Professions (Cincinnati, Ohio, USA). We searched other seminal historical articles and reference textbooks to identify existing definitions of the carotid siphon.

RESULTS AND DISCUSSION

Moniz's Initial Description of the Carotid Siphon

The term *carotid siphon* first popularly emerged in Moniz's 1933 *Lancet* article, "Cerebral Angiography" (12), and was later similarly described in his 1934 monograph (13). As the first to apply cerebral angiography clinically, Moniz was crucial toward ensuring its safety and appropriateness by careful clinical observations obtained from >300 angiograms. He emphasized the relevance of this technology in the diagnosis of aneurysms and brain tumors.

Describing the radiographic silhouette of the normal ICA, Moniz noted a series of bends and curves that he termed the *carotid*

ANATOMY

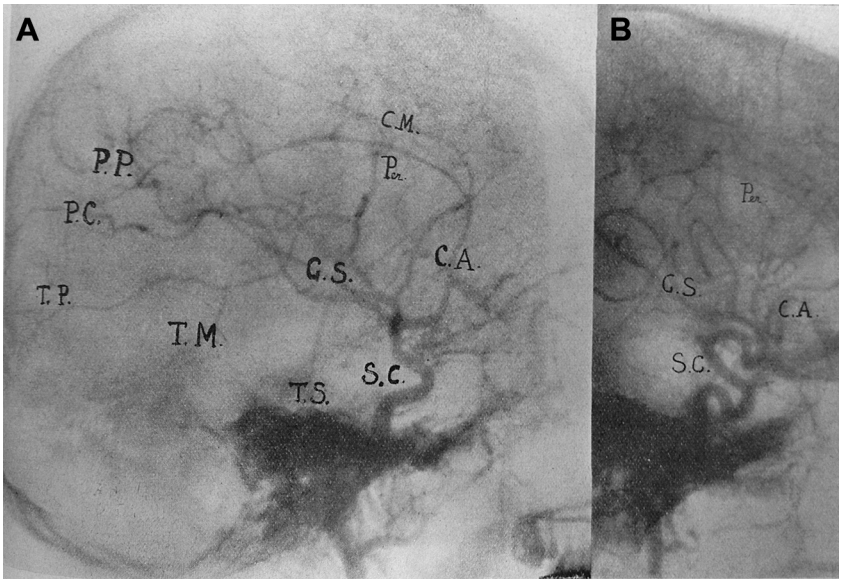

Figure 1. Cerebral angiograms from Moniz's 1933 *Lancet* article depicting the bends of the internal carotid artery and introduction of the terms *single siphon* (**A**) and *double siphon* (**B**). S.C., siphon carotidien (carotid siphon). (From: Moniz E: Cerebral angiography. Lancet 222:1144-1147, 1933 [12].)

siphon (Figure 1A) and an additional curvature in 70% of patients that he termed the *double siphon* (Figure 1B). Throughout Moniz's works, the term *carotid siphon* appeared in both the text and the figures; the latter included its corresponding abbreviation "S.C." (*siphon carotidien*). However, neither Moniz's writings nor his figures clearly delineated the boundaries of the carotid siphon.

An excerpt from Moniz's 1933 *Lancet* article describing the intracranial ICA demonstrates the difficulty in applying the term *carotid siphon* to definitive anatomic regions: "… an anterior bend which traverses the cavernous sinus and another which lifts the artery. The whole is really more complicated. After this second bend, the artery curves forward and immediately backwards again. We call this complex the *carotid siphon*."

With Moniz's anatomic description, varying interpretations are possible. As we attempted to analyze his terms and concepts, we adapted the terminology for ICA segmentation described by Bouthillier et al. (1) and subsequently modified by Depowell et al. (3) (Figure 2). In Moniz's initial description, it is unclear if he is referencing the entire carotid siphon, including both the bends and the curves, or if he is describing the proximal intracranial ICA with the first 2 bends and the carotid siphon with the latter mentioned curves. Assuming the latter, Moniz's first bend correlates to the C2 bend, and the second bend correlates to the C3-4 bend that lifts the artery. The forward and backward curves, seen in Figure 3A, would be termed the *carotid siphon* and would correlate to the cavernous and intradural portions of the ICA. However, Moniz stated that the first bend traverses the cavernous sinus; the observation is incongruous with this interpretation because the petrous segment of the ICA is not cavernous. The petrous carotid is often difficult to visualize in these early radiographs. Alternatively, if the entire statement describes the carotid siphon and the first bend is intracavernous, we conclude that the first bend is the C4 bend, and the second bend that lifts the artery is the C4-5 bend. Although this interpretation remedies the error with the previous argument, the artery goes backward and forward rather than forward and backward in Moniz's image (Figure 3A).

In Moniz's 1934 monograph, an image (Figure 3B) depicts that the artery goes immediately forward and backward again at the carotid terminus (13). This description of the carotid siphon incorporates both the carotid terminus and the anterior and

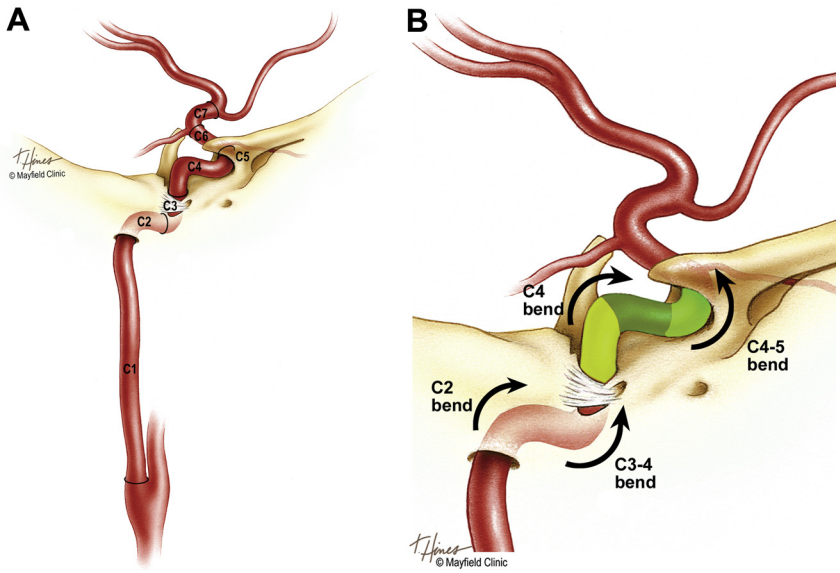

Figure 2. Classification numbering systems of the internal carotid artery. A 7-segment anterograde classification system (**A**) proposed by Bouthillier et al. (1) was later modified to include the arterial bends (**B**) by Depowell et al. (3). The C2 bend transitions from a superior course to an anteromedial course. The second bend, the C3-4 bend, redirects the artery in a superior direction toward the posterior clinoid process. The C4 bend changes the direction of the artery anteriorly, followed by the final C4-5 bend that directs the artery superiorly and then posteriorly. (Used with permission from Mayfield Clinic.)