



Contributions to our modern understanding of spina bifida: Camille Dareste (1822–1899)

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Background

The contributions of French academic Gabriel-Madeleine-Camille Dareste de la Chavanne (1822–1899) to the field of developmental anatomy and embryology have only rarely been documented in the extant medical literature. Dareste is best known for his investigations within the field of teratology, a branch of anatomy dedicated to understanding the genesis of congenital abnormalities and deformations [1]. Although following in the footsteps of predecessors such as Isidore Geoffroy Saint-Hilaire, Dareste's writings and discoveries were more concretely supported by numerous experiments and observations than previous works in the field of teratology [2]. Widely considered his opus magnum, Dareste's treatise *Recherches sur la production artificielle des monstruosité, ou Essais de tératogénie*, significantly broadened contemporary knowledge of the natural factors, such as temperature, that affect embryological development [2].

Beyond attempting to artificially generate pathologies, Dareste also studied the formation of neural tube defects (NTDs) such as spina bifida and split cord malformations in human and chick embryos in the late 1800s (Fig. 1 and cover figure). Such malformations were also noted by Dareste to be skin covered and to have hypertrichosis (focal hirsutism) of the midline lumbar spine. His

observations led him to posit that NTDs such as spina bifida were the result of failed neural tube closure during early embryonic development, a contentious position at the time [3]. Dareste's detailed notes of various observations helped to support his claims. In one passage from his *Recherches sur la production artificielle des monstruosité*, Dareste summarizes his findings from the dissection of a young human embryo with spina bifida, "...the unclosed section of the spinal cord, which was termed the *medullary patch*, showed the same nervous structures as the tubular section...The *medullary patch* was therefore only a portion of the neural fold still sprawled out, having failed to form a tube" [4].

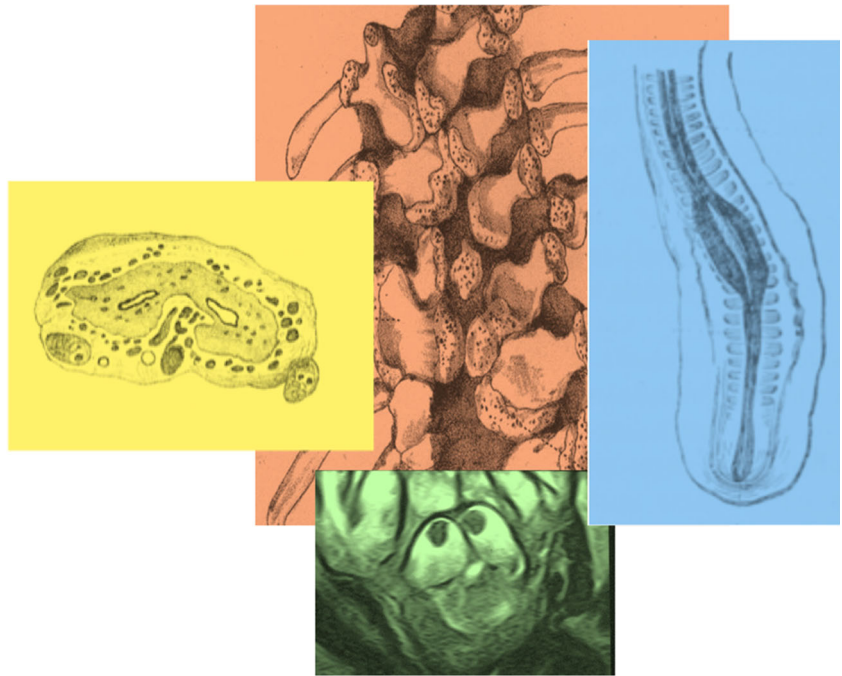
Conclusions

Using such findings and over 100 years ago, Dareste and his contemporaries, such as von Recklinghausen (1833–1910), challenged the belief introduced by Morgagni (1682–1771) that most NTDs were the result of overdistension of the neural tube following closure, rather than a failure of the closure events in the first place. Modern understandings of neurulation and NTDs have supported the assertions of Dareste, cementing his contributions to the field of developmental anatomy [5].

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Fig. 1 and cover figure Daresté's (1891) artificially induced split cord malformation (right), axial section of postmortem specimen with split cord malformation from Chiari (1896) (left), axial MRI of patient with split cord malformation (bottom center), and drawing of spine from patient with split cord malformation from Humphry (1886)



Compliance with ethical standards

Conflict of interest The authors have no conflicts of interest to report.

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