'Infantile convulsions' in the early nineteenth century. Abnormal brain blood flow and leeches, teething and gums' scarification and food and purgatives: the historical contribution of *John Clarke* (1760–1815)

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Abstract

In this article, we discuss on the role of the British physician and midwifery practitioner *John Clarke* (1760–1815) in the characterisation of the various types of seizures and epilepsy and related phenomena ('convulsions') occurring in children. In his unfinished work *Commentaries on Some of the Most Important Diseases of Children* (1815), Clarke discussed the pathophysiology of convulsions and was the first to describe, 12 years before the French neurologist *Louis Francois Bravais* (1801–1843) and more than 30 years before the Irish-born physician *Robert Bentley Todd* (1809–1860), the postictal paresis. He believed that convulsions originated from changes in pressure within the ventricles as a consequence of abnormal blood flow to the cerebral vessels. In keeping with the theories of his time (e.g. Baumes 1789, 1805; Brachet 1824), Clarke believed that teething was a major cause of 'infantile convulsions'. His proposed remedies ranged from scarification of the gums to ammonia, application of leeches, cold water, and purgatives. The use of antispasmodics, quite popular at the time, was instead questioned. In his *Practical Observations on the Convulsions of Infants* (1826), the London practitioner and midwifery *John North* (1790–1873) deeply criticised Clarke's view that convulsions arise inevitably as a consequence of organic brain lesions. North inferred that the results of autopsies of children who had died of convulsions revealed no brain damages, and claimed that cerebral irritation could also occur as the effect of distant lesions. Other Clarke's contemporaries (e.g. *Jean Baptiste Timothée Baumes*—1756–1828) inferred that all convulsions reflected a hereditary diathesis, which rendered children (especially those with softer and limper nervous and muscular tissues!) extremely sensitive to all sorts of provocation that could trigger convulsions, including bad digestion (more pronounced at the time of teething), loud noise, and bright light. Although almost every aspect of Clarke's view on convulsions was subsequently proved wrong, his (and his contemporaries') work provides fascinating insights into the theories and therapies of seizures, which were popular at the dawn of modern neurology.

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Introduction

At the beginning of the nineteenth century, several books entirely devoted to childhood convulsions were published [1].

In France, *Jean Baptiste Timothée Baumes* (1756–1828), professor of Medicine at the Faculty of Montpellier, wrote “*Des convulsions dans l’enfance, de leurs causes, et de leur traitement*” (*On Convulsions in Infancy, Their Causes, and Their Treatment*—Nîmes, 1789; 2nd edition—Paris, 1805) [1789, 1805] [2, 3, 17] and *Jean Louis Brachet* (1789–1858), French physician and surgeon, experimental neurophysiologist, and pathologist at the Hospital of Lyon [31], published “*Mémoire sur les causes des convulsions chez les enfants et sur les moyens d’y remédier*” (“*Memories on the Causes of Convulsions in Infancy, and on Their Means of Treatment*”) [1824] [8], which was awarded the annual prize of the *Circle Médical* of Paris [17].

The first monograph, written in English discussing childhood epilepsies, was however John Clarke’s “*Commentaries on Some of the Most Important Diseases of Children*” [1815]. John Clarke (1760–1815) [10] (Fig. Fig. 1 and Cover) was an English physician who wrote extensively about convulsions and other diseases in children and was held in high esteem among his contemporaries. Clarke was “naïve to electrical and neurochemical aspects of brain function” [32], which have been developed later during the nineteenth century particularly by the German anatomist, anthropologist, traveller and physiologist *Gustav Theodore Fritsch* (1838–1927); the German neurologist and neuropsychiatrist *Eduard Hitzig* (1838–1907); and the British neurologist *John Hughlings Jackson* (1835–1911). Nevertheless, Clarke’s work provides fascinating insights into the theories and therapies of convulsions, which were popular at the beginning of the nineteenth century.

In this article, we discuss Clarke’s role in the characterisation of convulsions occurring in children, as presented in his major book [10].

John Clarke and his times: the changes in health and well-being of children

The British physician and midwifery practitioner *John Clarke* (1761–1815) was born in Wellingborough in Northamptonshire on 19 December 1760, as the eldest son of a surgeon of the same name [15, 19, 32]. In 1772, the family moved to London, and in 1779, he began to study medicine there. He was initially educated at St. Paul’s School and then received his formal medical education at St. George’s Hospital. As member of the Corporation of Surgeons, he began practicing in Chancery Lane, while lecturing on midwifery in the medical school founded by Dr. John Hunter [19, 32]. In 1787, he received a license in midwifery from the College of Physicians and in 1791 obtained the University degree of

Fig. 1 and cover Dr. John Clarke (1760–1815), licentiate in midwifery of the Royal College of Physician. From an engraving originally published in 1813, held by the RCP Library. © Royal College of Physician and Wellcome Library

Doctor of Medicine [15, 27, 32]. Childbirth was traditionally under the control of women with no formal qualifications. During the eighteenth century, medical men gradually became more involved [15]. Initially, as they were only called to difficult births, their presence was associated with unfavourable outcomes. Therefore, women were reluctant to accept them during labour [15]. However, as more male doctors became involved in childbirth, their presence and influence seemed to improve results. This increase in the number of ‘*men-midwives*’ coincided with a general surfeit of medical men and raised prejudice against them. It was felt that their access to families during pregnancies would give them an unfair advantage if they later wanted to act as physicians [15]. It was felt that their access to families during pregnancies would give them an unfair advantage if they later wanted to act as physicians [3]. In 1771, the college revised its statutes and effectively banned from the fellowship anyone who had practised ‘as an apothecary or obstetrician or as a tradesman’ [4]. However, the college, recognising that there were distinguished and knowledgeable practitioners in midwifery, issued special licences limited to obstetrics between 1783 and 1800 [3]. John Clarke was one of 10 people licensed in this way [15, 32]. He was active as midwifery practitioner for several years, and then acted as consultant on the diseases of women and

children. He worked as physician in the lying-in hospital on Store Street and the Asylum for Female Orphans of London, and as lecturer on midwifery at St. Bartholomew's Hospital, before semi-retiring from practice due to a stomach illness and ascites, from which he later died [15, 32]. Clarke was member of several medical societies, including the Lyceum Medicum Londinense and The Medical and Chirurgical Society of London (now the Royal Society of Medicine) [15].

Clarke lived in an 'age of theorists and systematists' where science took charge and new medical disciplines were began by great innovative minds, including pathological surgery by the British army-surgeon *John Hunter* (1728–1793); preventive inoculation (i.e. immunisation) by the English country physician-surgeon, scientist and naturalist *Edward Jenner* (1749–1823); public hygiene by the American physician, poet and polymath *Oliver Wendell Holmes* (1809–1894); embryology by the German anatomist, biologist and embryologist *Caspar Friedrich Wolff* (1733–1794); and medical bibliography by the Swiss anatomist, physiologist, naturalist and poet *Albrecht von Haller* (1708–1777) [15, 32]. Clarke and his contemporaries, largely before the pioneering antiseptic procedures of the Hungarian physician of ethnic German ancestry *Ignaz Semmelweis* (1818–1865), faced a marked change occurring in the health and well-being of children, recording the abrupt decrease of death rates for children in London by half (from 63 to 31.8 deaths per 100), largely due to the changing attitudes on midwifery and on nutrition, vaccination and hygiene during infancy [15, 24, 25], as well as the emergence of a science of child care, which evolved to include care for the prematurely and the newly born, and even the unborn [32].

Besides his *Commentaries on Some of the Most Important Diseases of Children* [1815] [10], which remained unfinished because of his death in 1815 (almost certainly by stomach cancer) [15], he wrote "*An Essay on the Epidemic Disease of Lying-in Women in 1787-8*" [1788] and "*Practical Essays on Pregnancy and Labour, and the Diseases of Lying-in Women*" (1793) [19, 32]. From an historical perspective, Clarke's *Commentaries* is worth mentioning, as it contains the first exact description of laryngospasm accompanying tetany [15, 19, 32]. Two chapters of this book deal extensively with seizures in children (chapter IV) and their treatment (chapter V).

Epidemiology of convulsions in children

Clarke's *Commentaries on Some of the Most Important Diseases of Children* [1815] [10] starts providing data on mortality among children. Data are taken from the bills of mortality for 40 years, from the year 1760 to the year 1799. Here Clarke writes that

"Upon consulting the bills of mortality it is impossible not to be struck forcibly with observing the great numbers of persons who are there stated to have died of

convulsions. The age of those who have been victims to this and other diseases, is not, however, noticed" [10].

Elsewhere, Clarke reports the data of a survey made at the end of the year 1792, showing that

"...of 17,650 children born in the Lying-in Hospital of Dublin, a sixth part died during the first year of their existence, and that nineteen out of twenty fell victims to convulsions" [22].

When describing epileptic seizures occurring in children, he also notes that

"In one of these attacks a child sometimes, but not frequently, dies....." [10].

Clinical description of convulsions in children

The chapter devoted to convulsions (chapter IV: On Convulsions) starts with a detailed clinical description of these phenomena. Although "*Convulsion [...] is a very vague term, and many diseases have been designated by it*" [10], in this chapter, he dealt only with "*those convulsions, any single paroxysm of which agrees with the ordinary definition of epilepsy*" [10].

He describes childhood convulsions as

"..... an universal spasmodic contraction of all the voluntary and many of the involuntary muscles of the body, accompanied by foaming at the mouth, protrusion of the tongue, staring of the eyes, distortion of the eyeballs, laborious and obstructed respiration, sometimes accompanied with a violent redness of the face and scalp, in the beginning of the paroxysm, followed by a purple colour of the whole body, at the end of it. This latter symptom sometimes continues till the child dies" [10].

Of note, Clarke also referred to the postictal paresis, later described by *Louis François Bravais* (1801–1843) in 1827 [9] and by *Robert Bentley Todd* (1809–1860) in 1849 [29], who finally received the credit by the medical community, for calling it now Todd's paresis [4]. This paralysis can involve only one side of the body and be reversible, as Clarke already described in 1815 [10]:

"Sometimes, after one or more paroxysms, the child remains paralytic; it loses the mobility of the lower limbs, or of one side of the body. The power of moving the extremities, in some instances, returns after a considerable time, in a partial degree" [10].

Robert Bentley Todd's description 34 years later was as follows [4, 23]:

“A paralytic state remains sometimes after the epileptic convulsion. This is more particularly the case when the convulsion has affected only one side or one limb: that limb or limbs will remain paralytic for some hours, or even days, after the cessation of the paroxysm, but it will ultimately perfectly recover” [29].

Pathophysiology of convulsions: ventricles’ pressure and abnormal brain blood flow

John Clarke did not systematically discuss the pathophysiology of convulsions. However, throughout his book, he made some reference to it. He believed that *“Convulsions, as far as the experience of the writer enables him to judge, are never an idiopathic disease, but may generally be traced to some pre-existing cause” [10].* John Clarke’s view of convulsions contrasted with the dominant one, proposed by the English physician and surgeon Michael Underwood (1736–1820) in 1789 [30]. Underwood (known for the first accurate description of poliomyelitis) [13] had differentiated symptomatic convulsions, *“depending upon another disease”,* from idiopathic convulsions, *“said to be an original complaint, and arising from a morbid affection of the brain”.* On the contrary, Clarke believed that *“in every case of convulsion (be the remote cause whatsoever it may) the brain is at the time organically affected, either directly or indirectly” [10].* Among direct causes of brain involvement Clarke listed *“phrenitis, hydrocephalus, or on the sudden retiring of cutaneous eruptions, or of inflammation of the mucous membrane of the eyelids and eyes, or when they appear on the accession of some cutaneous disease, attended with febrile symptoms, especially scarlet fever, small-pox, and (sometimes, though less frequently) of measles” [Clarke, 1815].* However, distant lesions could also cause a brain damage *“indirectly, as when they are occasioned by an overloaded stomach or by indigestion, by peripneumony, by inflammation, or suppuration in the cavity of the pericardium, by glandular or other humors pressing on the large vessels leading to the lower extremities, or when they take place in the progress of infantile fever, or in marasmus” [10].*

Clarke believed that the mechanisms leading to convulsions involved changes in pressure within the ventricles as a consequence of abnormal blood flow to the cerebral vessels. As surprising as it may seem, this theory dates back to the Greek physician, surgeon and philosopher of the Roman Empire Galen of Pergamon (129–201 AD), who thought that convulsions emanated from the ventricles when they became intermittently blocked by phlegm [7]. They could arise from within the brain or from other sites acting upon the brain. Over

centuries, through the works of Galen of Pergamon (second century) and of the Greek Byzantine physicians and philosophers Leo of Thessalonica (the Iatrosophist) (790–869 AD), Michael Psellos or Psellus (1017–1078 AD) and Johannes Zacharias Actuarius (1275–1328 AD) [11], this would have led to the concepts of idiopathic, symptomatic and sympathetic convulsions, which were eventually systematised in 1854 by the French neuropsychiatrist and pioneer in child neurology, Louis Jean François Delasiauve (1804–1893) [12].

According to Clarke, the changes in pressure within the ventricles were an explanation for the transitory illness and paroxysmal occurrence of convulsions:

“It has been urged, that if convulsions were produced by a scrophulous or bony tumor pressing on the brain, they should be more constant — but in fractures of the skull, with depression from sudden accidents, convulsions are not constantly present, and it is most probable, that they are immediately excited in both cases by some increase of pressure, occasioned by an acceleration of the circulation” [10].

Other contemporaries of Clarke (e.g. Baumes) [1789, 1805] inferred that all convulsions reflected a hereditary diathesis, which rendered children (especially those with softer and limper nervous and muscular tissues!) [26] extremely sensitive to all sorts of provocation that could trigger convulsions, including bad digestion (more pronounced at the time of teething), loud noise and bright light. These triggering phenomena well explained nowadays some causative factors in some forms of focal (lesional) idiopathic, or genetic epilepsies, reflex seizures, hyperekplexia and cow milk (immune-mediated) seizures.

Proposed remedies: teething, foods, gums’ scarification, leeches and purgatives

The abnormal blood overflow to the brain provided the rationale for therapy:

“As there is strong reason, from the circumstances above stated, for believing that in the greater number of cases, where convulsions occur, the head is overloaded with blood, it will be right to take away blood by leeches, by cupping, or by opening the external jugular vein” [10].

It is therefore not surprising that Clarke, just as many of his contemporaries and predecessors, recommended bloodletting:

“It does not appear from the experience of the writer that any inconvenience can arise from taking away blood: but if it should be neglected, much mischief

may ensue, which the loss of blood would prevent. When, by the use of the means above suggested, convulsions have not been relieved, recourse may be had to blistering the lower extremities” [10].

In keeping with theories of the time, Clarke considered *teething* a major cause of infantile convulsions [24,25]. Clarke explicitly referred to the Greek physician of the age of Pericles *Hippocrates of Kos* (460–370 BC), who had described an association between convulsions and teething (“at the approach of dentition, pruritus of the gums, fevers, convulsions, diarrhoea” [10; 1815, translated by Francesco Brigo], and to other subsequent authors including the German academic physician *Daniel Sennert* (1572–1637) [10]. Of note, the observed association between teething and infantile convulsions was probably true, although spurious: it was not dentition, which was responsible for convulsions, but the associated raised body temperature (febrile seizures) [21] teething continued to be considered culprit for several children ill during the entire nineteenth century. Then, gradually, it was assumed that (the fever and) the food replacing breast milk during weaning—which usually coincided with dentition—was more likely to cause convulsions than teething itself [18]. Baumes, himself, years before the publication of Clarke’s treatise on convulsions [i.e. in his 1789 specialised treatise on convulsions] [2], discussed the fact that pieces of solid food (e.g. meat, chestnuts, or truffles), if fed to a child at the time the teeth first appear, will cause problems, because the child cannot chew such foods properly, and therefore, the foods would pass almost whole into the stomach causing hiccup and vomiting, predisposing in turn the child to convulsions.

For convulsions associated with dentition, the remedy proposed by Clarke consisted in *scarification of the gums*:

“If convulsions take place in children at the age when dentition commonly occurs, an examination should be made of the state of the gums, and if they are even full, it will be useful to scarify them, but if they appear to be inflamed, the scarification of them should be very freely made, so as not only to take away some blood from the part inflamed, but also to remove the whole tension of the gums and of the membrane which covers the tooth. This membrane, under inflammation, becomes extremely sensible to pain, and being stretched upon the tooth, requires to be entirely set at liberty. — When convulsions occur in dentition, the lenity of the surgeon who omits to destroy the inflamed gum sufficiently with the knife, is ill-judged, and is in effect, the greatest cruelty to the child. — The writer has seen many cases in which convulsions have ceased on scarifying the gums extensively after slight incisions of them had failed to produce any advantage” [10].

The scarification of gums was thought to be able to lead to cessation of the convulsions upon the removal of the local irritation, which had indirectly affected the brain. Clarke also recommended the use of *purgatives*, such as calomel, infusion of senna with manna, and tincture of jalap:

“The bowels should be emptied speedily by glyster, under all circumstances, and by some active purgative administered as speedily as possible, and repeated at short intervals till copious evacuations have been procured” [10].

The use of purgatives was very popular at the time and remained in use during the whole nineteenth century, as an anonymous editorial on the treatment of status epilepticus published in 1905 clearly shows: “As gastrointestinal disorders, especially constipation, often act as determining causes of the convulsive seizures, the closest attention should be given to the quantity and the quality of the food and the state of the digestive organs and their activities” [reported in 20]. The effectiveness of purgatives would have been assessed, later on in the nineteenth century, among the others, by the French psychiatrist *Jean-Étienne Dominique Esquirol* (1772–1840) [14] and by the French neurologist, pathologist and talented politician *Désiré-Magloire Bourneville* (1840–1909) [5], who nonetheless provided unsatisfactory reports on their use [20, 28]. Notably, Bourneville, who is most well known for his first detailed description of tuberous sclerosis [6], used (along with his colleagues at the Pitié-Salpêtrière in Paris) purgatives (as well as quinine, bromide of camphor, amyl nitrite and application of ‘leeches’ behind the ears) for treating seizures in the 15-year-old Marie, the unfortunate girl who at autopsy had “*sclerotic tubers in... her... brain convolutions*” [6]. Baumes [1789, 1805] [2, 16] also described children with epileptic convulsions caused by excess of fruit and milk and cured by purging.

Clarke also suggested using “*warm bath at the temperature of 92 or 94 degrees of Fahrenheit’s scale*” [10]. This was considered useful “*by diffusing the circulation more generally, and especially determining it to the surface of the body*” [Clarke, 1815]. A warm bath could lead to a more widespread redistribution of blood to the body surface, reducing the blood overload in the brain, which was thought to be responsible for the convulsions.

Conversely, Clarke reported that “*In inflammation of the brain in children, as well as in adults, the application of cold fluids or ice to the scalp, (previously shaved), has been attended with the best effects, and it is a very useful remedy in the case of convulsion*” [10]. The cold application could effectively reduce the presumed blood overflow to the brain, thanks to the vasoconstriction it was able to induce. The reported efficacy of this remedy against convulsions occurring as a consequence of *inflammation of the brain* could actually

“No other compositions should be directed but those which are known. Popular and empirical nostrums, under the specious names of Fit Drops, &c. will always be obtruded on the public (till more attention is paid by the higher orders of practitioners to the complaints of children) by interested persons; but it would be disgraceful to a medical man to countenance by his assent, and still more by his approval of the use of such unknown compounds, because his authority will naturally have a great weight in confirming the credulity of those persons, whose anxiety supersedes the use of their reasoning faculties. — A mother in distress will catch at any suggestion of a remedy for her child: but the reason of a medical attendant will often check such a disposition by pointing out more probable modes of relief” [10].

Most of these *natural* remedies, however, did not work at all, and the recorded effects at those times belonged more likely to the natural history of the specific type of seizures and epilepsy treated.

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Clarke's influence over his contemporaries

The figure of John Clarke was held in high esteem among his contemporaries. In an historical perspective, his fame relies mainly on his description of laryngospasm accompanying tetany [15, 19, 32]. In his *Practical Observations on the Convulsions of Infants* (1826), the London practitioner and midwifery John North (1790–1873) deeply criticised Clarke's view that convulsions inevitably arise as a consequence of brain organic damage. North reported the results of autopsies of children who had died of convulsions and in whom no brain damages were found, and claimed that *cerebral irritation* could also occur as the effect of distant lesions:

“That in most cases of convulsions there is some functional disturbance of the brain, is not only probable but certain. It is also true, that organic disease of the brain may originally exist as their cause, or be subsequently consequential to them. But we must pause before we assent to, or shape our practice by, the unlimited statement of Dr. Clarke. Although we have presumed that an irritation of the brain may be assigned with much probability as the frequent cause of convulsions, this is very far from coinciding with the doctrine which would teach us that the brain is organically affected. The recorded examinations of the bodies of children who have died from convulsions, show also that in most cases no organic lesion of the brain existed. Facts are constantly presented to us, which would appear to prove that convulsions frequently depend upon irritation of the extremity of the nerves, and not upon irritation of their cerebral origins. So long as any local irritation exists, so long do the convulsions continue, whatever maybe the treatment adopted. If convulsions arise from teething, they will in many cases cease almost instantaneously upon the division of the gums, — upon the removal of the local source of distress” [22].

North also questioned the need for drastic therapies in all cases of convulsions in children, claiming that *“the practice which has been founded upon this doctrine [John Clarke's doctrine] was neither contemplated by him, nor would have received his sanction” [22].*

Conclusions

John Clarke's *Commentaries on Some of the Most Important Diseases of Children* is historically relevant as it represents the real first monograph explicitly and extensively discussing convulsions in children published by an English author.

Although its content does not appear to be innovative or original, it nonetheless provides fascinating insights into the theories and therapies of convulsions, which were popular at the beginning of the nineteenth century. In addition to that, outstandingly Clarke was the first to describe, more than a decade before *Bravais* and more than 30 years before *Todd*, the postictal paresis. Although almost every aspect of Clarke's view on convulsions was subsequently proved wrong, his conceptions of convulsions are a fascinating and living testimony of the theories on convulsions at the dawn of modern neurology and paediatric neurology.

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