



Historical Issues in Sleep Medicine

Ondine's curse: myth meets reality

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ABSTRACT

Ondine's curse is one of the most enchanting mythical tales in the field of Medicine. The nymph Ondine was an immortal water spirit who became human after falling in love for a man, marrying him, and having a baby. In one of the versions of the tale, when she caught her husband sleeping with another woman, she cursed him to remain awake in order to control his own breathing. During the 19th century, the rare syndrome characterized by loss of autonomic breath control, while voluntary respiration remains intact, was cleverly named "Ondine's curse". Nowadays, the term Ondine's curse is usually associated with congenital central hypoventilation syndrome; however, in medical literature, it also designates several respiratory disorders. Here, we present a review of the myth focused on history, arts and medicine.

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1. Introduction

The Ondine's curse or syndrome was originally termed to describe an extremely rare condition associated with failure of respiration center automaticity [1], being nowadays commonly associated to congenital central hypoventilation syndrome (CCHS, MIM 209880). However, it can be found in medical literature designating several neurological disorders, from isolated respiratory dysfunctions to complete brainstem injury, including central alveolar hypoventilation syndrome (CAHS), failure of automatic ventilation and central sleep apnea (CSA), distinct from obstructive sleep apnea [2–6]. This study reviews the rich story of Ondine's myth and its relation with medicine and arts.

2. The Ondine legend in the arts

The name Ondine, also known as Undine, Undin or Undina, derives from the Latin word "unda" (wave), and it was used to nominate a category of supernatural females including nymphs, limnads, nereids, naiades and mermaids, associated with the

classical element water [7]. Although the classical 15 books *Metamorphoses* by Ovid (Publius Ovidius Naso, 43 BCE–17/18 CE) already described creatures similar to nymphs [7], the man behind the term "ondine" seems to be Theophrastus Philippus Aureolus Bombastus von Hohenheim (1493–1541), better known as Paracelsus [8]. In his alchemical writings, he stated that each of the four classical elements was inhabited by invisible, spiritual counterparts of Nature, thus the elemental being associated with water was named *undine* [2].

Ondines have origin in Greek mythologic figures known as Nereids, attendants of the sea god Poseidon [2]. Paracelsus first mentioned Ondine in his writings after he found the story in the German poem *Der Ritter von Staufenberg* (1480), and in 16th century a nymph named Ondine was also cited in the poem *Hylas*, written by Pierre de Ronsard (1524–1585) [2]. However, the main author associated with the popular fairytale "Undine" is Friedrich Heinrich Karl, the German Baron de la Motte-Fouqué (1777–1843), who in 1811 wrote the novella *Undine* [9]. It probably exerted an influence on Hans Christian Andersen (1805–1875), who wrote in 1836 the adaptation *The Little Mermaid* [10]. In 1842, Aloysius Bertrand (1807–1841) introduced the prose poem in French literature, publishing a collection entitled *Gaspard de la Nuit*, including a poem called Ondine [11]. In 1908, Maurice Ravel (1875–1937) composed a "hard to play" piano suite named *Gaspard de la Nuit*, which first movement was also called Ondine [12].

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The play *Pelléas et Mélisande*, written in 1892 by Maurice Maeterlinck, was in part based on the Ondine myth (1862–1949) [13], and it was adapted to the opera in 1902 by Claude Debussy (1862–1918) [14]. Likewise, contemporary composers were stimulated by that play, as the symphonic poem *Pelléas et Mélisande* (1903) by Arnold Schoenberg (1874–1951) [15], the *Opus 46* (1905) by Jean Sibelius (1865–1957) [16], and the incidental music *Opus 80* (1912) by Gabriel Urbain Fauré (1845–1924) [17]. Other operas associated to the myth include the librettos *Ondine* (1816), by E.T.A. Hoffmann (1776–1822) [18]; *Undine* (1845), by Albert Lortzing (1801–1851) [19]; and *Undina* (1869), written by Vladimir Sollogub (1813–1882) [20] to the opera by Pyotr Tchaikovsky (1840–1893) [21]. More recently, Yukie Nishimura (1967-) also composed a piano piece called *Undine* in 1988 [22].

Ballet choreographies related to the myth include *Les Sylphides* (1909), produced by Michel Fokine (1880–1942) [23]; and *Ondine* (1958) by Sir Frederick Ashton (1904–1988) [24] performed by Margot Fonteyn (1919–1991) [25].

In 1939, Jean Giraudoux's (1882–1944) play *Ondine* introduced to the public the concept of loss of automaticity of all functions, including breathing, moving, seeing and hearing, as Ondine's curse: "Since you went away, I've had to force my body to do things it should do automatically. I no longer see unless I order my eyes to see (...) I have five senses, thirty muscles, even my bones to command; it's an exhausting stewardship. If I relax my vigilance for one moment, I may forget to hear or to breathe" [26]. Ondine's husband probably died because he renounced to breathe [2]. Although in an excellent review of the ancient stories Nannapaneni et al. [2], found no versions in which Ondine cursed her husband, the later writers freely developed the water nymph fairytale. In one of these versions, Ondine was a beautiful nymph blessed with immortality and eternal youth; however, she could lose her gifts if she gave birth to a human child. When she fell in love with a man, he swore to her: "My every waking breath shall be my pledge of love and faithfulness to you!" That choice of words would become fateful; they happily married and had a baby, thus she became human, grew old and lost her beauty. One day, she caught her husband sleeping with another woman; she woke him up and cried: "You pledged faithfulness to me with your every waking breath, and I accepted that pledge; so be it; for as long as you are awake, you shall breathe, but should you ever fall asleep, your breathing shall cease." [27].

The Ondine's legend continued to live in arts, through sculptures such as *Undine Rising from the Waters* (1880) by Chauncey Bradley Ives (1810–1894) [Fig. 1] [28], and the *Undine* (1930) by Giuseppe Renda (1800–1899) [29]. There is also a huge collection of paintings including *Ondine* (1843) by Jacques-Laurent Agasse (1767–1849) [30]; *Undine* (1872) and *Hylas and the Nymphs* (1896) [Fig. 2] by John William Waterhouse (1849–1917) [31]; *In the Waves (Ondine)* (1889) by Paul Gauguin (1848–1903) [Fig. 3] [32]; *Ondine (Silver Fish)* (1899) by Gustav Klimt (1862–1918) [33]; and *Undine at the Window* (1915) by Arthur Rackham (1867–1939) [Fig. 4] [34].

Several movies were produced inspired by the myth. Andy Warhol (1928–1987) directed the film *The Loves of Ondine* (1967) [35], and the animated motion picture by Walt Disney Productions *The Little Mermaid* also popularized the legend in 1989 [2]. It became a Broadway's stage musical, produced by Disney Theatrical and nominated to Grammy award in 2007, with music by Alan Menken (1949-) [36]. One of the stories from anthology film *Shake, Rattle & Roll III* (1991) featured a lake creature named Undin [37], and the Irish movie *Ondine* (2009) told the story of a fisherman that caught a beautiful young woman in his net [38]. The 2013 Polish short documentary film titled "Our Curse", by Tomasz Sliwinski



Fig. 1. Sculpture titled "Undine Rising from the Waters" (1880) by Chauncey Bradley Ives (1810–1894) [28] [from: <https://artgallery.yale.edu/collections/objects/2729>. Accessed March 4, 2019, with permission of Yale University Art Gallery].



Fig. 2. Painting titled "Hylas and the Nymphs" (1896) by John William Waterhouse (1849–1917) [31] [from: <http://manchesterartgallery.org/collections/search/collection/?id=1896.15>. Accessed June 1, 2019. Image courtesy of Manchester Art Gallery].

(1979-), was Oscar-nominated; it recorded the first six months of his son Leo, with CCHS, "fighting against a curse of a cruel goddess Ondine" [39].



Fig. 3. Painting titled “In the Waves (Ondine)” (1889) by Paul Gauguin (1848–1903) [32] [from: <http://www.clevelandart.org/art/1978.63>. Accessed March 1, 2019, with permission of Cleveland Museum of Arts, Cleveland USA].

3. The Ondine's curse in medicine

Severinghaus and Mitchell [1] cleverly coined the term Ondine's curse in 1962 to describe a failure of respiratory center automaticity, which is especially important during sleep. Autonomic respiration depends on a feedback mechanism related to the levels of carbon dioxide and oxygen, as well as the pH of the blood and cerebrospinal fluid [40]. Respiratory control is regulated in two areas situated in medulla and one in pons: (1) the dorsal respiratory group, consisting of inspiratory neurons near the solitary nuclei of the medulla; (2) the ventral respiratory group, a column of inspiratory, expiratory and rhythm-generating neurons extending from the cervical cord C1 to below the facial nuclei; and (3) the parabrachial/Kölliker–Fuse complex (located in dorsolateral upper pons), which controls switching between inspiration and expiration [40,41]. The three groups of neurons are paired bilaterally, however even a unilateral injury may produce several degrees of hypoventilation or apnea [41].

There are about ~1000 congenital cases of Ondine syndrome published in medical literature, most of them CCHS due to a chemical disorder of breathing control [3]. It seems to be related to a mutation of the proneural *HASH-1* gene, causing impairment of development of noradrenergic neurons [3].

Acquired Ondine syndrome was first reported due to bulbar poliomyelitis [42], being later related to trauma, encephalitis, brainstem infarction and hemorrhage [4–6]. Furthermore, respiratory disturbances (including CSA) were also associated with cavernous malformation, osmotic demyelination syndrome, multiple sclerosis, Leigh syndrome, heterotopia of the inferior olive, mitochondrial and degenerative disease (eg, multisystem atrophy) [4,43–46]. Primary brainstem tumors, particularly gangliogliomas, have also been cited as a cause of Ondine syndrome [46–48]. Postoperative complications resulting in CSA were described after high cervical chordotomy for cancer pain [49], microsurgery for brainstem tumors such as meningioma with clear cells [50], and hemangioblastoma [41]. Likewise, dissecting vertebral artery



Fig. 4. Painting titled “Undine at the Window” (1915) by Arthur Rackham (1867–1939) [34] [from: <https://artgallery.yale.edu/collections/objects/15548>. Accessed March 4, 2019, with permission of Yale University Art Gallery].

aneurysm evolved with Ondine syndrome after endovascular treatment [40], while delayed presentation compatible with radionecrosis occurred two years after the resection of a cerebellar hemangioblastoma [51].

Since CCHS can be lethal without adequate treatment, immediate respiratory care is required, including intubation, tracheostomy, mechanical ventilation and intensive monitoring [40]. The pharmacological treatment seems to be ineffective to CSA [4,5], while oxygen supplementation may produce variable results in this population, sometimes increasing hypercapnia and further delaying the diagnosis [43]. CCHS commonly requires lifelong ventilatory support for all patients during sleep, and approximately one-third of patients need continuous assisted respiration when awake [5,52]. Although the literature suggests usefulness of non-invasive positive pressure ventilation in some cases [4], full-time ventilatory patients may benefit from diaphragm pacers, an alternative mode of ventilation that affords mobility and a more normal lifestyle [52].

The association of neurologic illness with sleep disorders is common, and both combined may have huge negative impact on the individual and society [53].

4. Conclusion

In medical literature, the term “Ondine's curse” has been applied to a myriad of conditions of respiratory dysfunction, however its knowledge allows early diagnosis and treatment, especially to avoid sudden death in children. The fascinating story of Ondine is an excellent subject to illustrate human creativity, love and tragedy, and it continues to represent a source of inspiration for innumerable artists today.

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CRedit authorship contribution statement

Zeferino Demartini: Conceptualization, Writing - original draft. **Luana Antunes Maranhã Gatto:** Writing - review & editing. **Gelson Luis Koppe:** Writing - review & editing. **Alexandre Novicki Francisco:** Writing - review & editing. **Enio Eduardo Guerios:** Writing - review & editing, Supervision.

Conflict of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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