EDITORIAL

Sleep Science

Michel Jouvet and his Importance for Brazilian Preclinical Sleep Research

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The world of sleep medicine received with great sorrow the sadly news of Michel Jouvet's death. He passed away on October 3rd 2017, in Villeurbanne, France, at the age of 91. Dr. Jouvet was one of the forefathers of sleep research, being responsible and involved in several of the main breakthroughs on the early years of sleep medicine.

Dr. Jouvet was initiated on the field of sleep research in Long Beach, California in 1954, by working on the laboratory of Horace Magoun (1907-1991), who have worked together with Giuseppe Moruzzi (1910-1986) on the identification of brain structures underlying sleep. Among his main research achievements are the description of muscle atonia during REM sleep, in 1959, which had been described only a few years before by Eugene Aserinky (1921-1998) and Nathaniel Kleitman (1895-1999). Jouvet realized that both cats (main animal model for sleep research at that time) and humans presented an almost complete muscle atonia during REM sleep. The contrast of the lack of muscles tonus with intense eletroencoegalographic activity led to the term "paradoxical sleep". He later worked on detailing the structures generating paradoxical sleep, reason why it was also referred to as "rhombencefalic sleep", in opposition to the "telencephalic" (i.e. NREM) sleep. More recently he worked on the discovery and clinical usefulness of modafinil, used on the treatment of narcolepsy and overall excessive daytime sleepiness.

The work of Dr. Jouvet has greatly affected Brazilian preclinical sleep research. The noteworthy article of Timo-Iaria et al.[1] which for the first time described the sleep phases and stages of rats based on electroencephalographic parameters, was much based on previous descriptions by Jouvet about the neurophysiology of sleep states and previous polygraph recordings in rodents[2,3]. The most impacting feature of Jouvet's scientific output to Brazilian sleep research might have been the description of the flower pot technique for paradoxical sleep deprivation in cats[3]. This method consisted in placing an animal on an inverted flower pot surrounded by water. The animal is able to sleep on this pot, but whenever it entered the REM sleep, it falls from the platform or touches is snout on the water due to the characteristic muscle atonia of this sleep stage, consequently awaking. Thus, this methods leads to a specific deprivation of REM sleep, while NREM sleep is reasonably preserved. This method was adapted to rats after a few years (Cohen and Dement, 1965) and refined to reduce stress due to locomotion restraints[4]. Afterwards, Brazilian researches have worked on further refinements, proposing the so-called modified multiple platform method[5], as well as testing variations and new applications for this methods[6-9]. Much of the Brazilian preclinical output in sleep research has been derived from the platform methods. On a quick search on Scopus for preclinical articles using platform-derived sleep deprivation methods, limited to journal articles published on the last decade (2007-2016), Brazil is ranked first, being the country which has mostly used this methods on preclinical sleep research (130 out of 418 articles – Figure 1). Noteworthy, several research groups on the country uses these methods. The most prolific research group on the field has been the one headed by Tufik and Andersen, at the Federal University of São Paulo, accounting for 95 out of 418 articles (23.4%). It has also been employed by the groups of De Bruin[10,11] (Federal University of Ceará), Suchecki[7,8,12-15] (Federal University of São Paulo), Lima[16-20] (Federal University of Paraná), Hoshino[9,21-24] (São Paulo State University) and many others. Finally, Sleep Science, the official journal of the Brazilian Association of Sleep, has published several articles based on platform-derived methods[16,17,23-25].

The impact of Jouvet's legacy on Brazilian preclinical sleep research is just one among several fields that have developed based on his achievements and discoveries. Undoubtedly, other fields, countries and individuals have grown based on his findings. As an example, the

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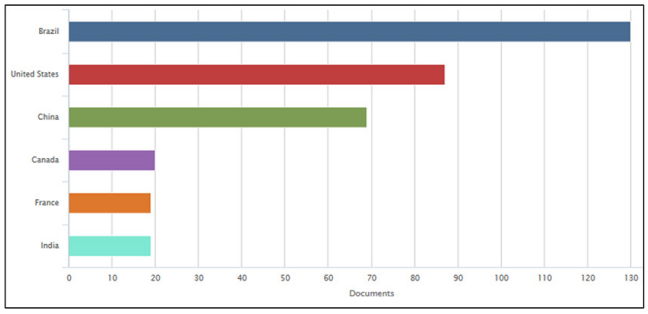

Figure 1. Research output or articles using platform-derived sleep deprivation methods during the last decade, ranked by country. Data extracted from Scopus, limited for journal articles published between 2007 and 2016, using the following search string: ((sleep AND (platform OR "flower pot" OR "rem sleep deprivation" OR "paradoxical sleep deprivation") AND (rat OR rats OR mice OR mouse OR murin* OR animal*) AND NOT rotating)).

clinical definition and all research about REM sleep behavior disorder only become possible due to Jouvet's observation of muscle atonia during paradoxical sleep in cats, as well as of oneiric behavior in animals[26]. In any case, as basic sleep researchers, we must recognize much of what has been achieved in recent years were only possible due to Jouvet's seminal works, on the decades of 60 to 80.

All the Brazilian sleep research community and specially those involved in preclinical research will greatly miss Michel Jouvet's brilliance and remarkable scientific insights. His work remains alive though, in all those who work to unravel the neurobiological basis of REM sleep and to dissect the effects of paradoxical sleep deprivation.

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