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Elio Lugaresi (1926-2015): A founding father of the history of sleep disorders

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Elio Lugaresi (1926-2015): A founding father of the history of sleep disorders

De Santo Rosa Maria¹

Abstract

The history of sleep disorder research began with the landmark 1953 paper by Aserinsky and Kleitman in *Science*, titled “Regularly Occurring Periods of Eye Motility and Concomitant Phenomena”. This field advanced on the shoulders of many giants, including Nathaniel Kleitman (Chicago), William C. Dement (Stanford), Henri Gastaut (Marseille), Elio Lugaresi (Bologna), Christian Guilleminault (Stanford), and Colin Sullivan (Sydney).

Elio Lugaresi (Castiglione di Cervia, July 1, 1926 – Bologna, December 22, 2015) was one of those giants who transformed Sleep Medicine into one of the most dynamic fields of research and treatment. Lugaresi graduated from the University of Bologna in 1952. During his residency in Neurology at the same university, he trained in polysomnography (PSG) with Henri Gastaut from 1956 to 1957 in Marseille. He connected clinical observations with PSG data, and, upon returning to Bologna, began working with Giorgio Coccagna and others to conduct PSG recordings using a rudimentary electroencephalograph.

The group produced seminal papers on (i) pulmonary pressures, arterial pressure, blood gases, breathing, and sleep; (ii) Restless legs syndrome and myoclonus; (iii) snoring and hypertension, which led to the identification of sleep apnoea as a risk factor for cardiovascular disease; and (iv) Fatal Familial Insomnia. In 1967, they organised the First International Congress on Sleep Medicine in Bologna.

As stated in an interview with the Italian Association of Sleep Medicine, Lugaresi was inspired by the Renaissance idea that all knowledge should stem from the observation of humanity. Even in his emeritus days, he worked successfully, producing more than 500 papers and chapters, which have garnered him a long list of awards and honours. William C. Dement, referring to the originality of Lugaresi’s work, argued, “It is not clear what would have happened if an Italian neurologist, Elio Lugaresi, had not become very interested in obstructive sleep apnoea”.

Key Words: *Elio Lugaresi, polysomnography, pulmonary pressure, arterial pressure, breathing, blood gases, fatal familial insomnia*

Introduction

The history of sleep disorder research began with the landmark paper by Aserinsky and Kleitman in 1953, published in *Science*, titled “Regularly Occurring Periods of Eye Motility and Concomitant Phenomena”.¹ This field progressed on the shoulders of many giants, including Nathaniel Kleitman (Chicago), William C. Dement (Stanford), Henry Gastaut (Marseille), Elio Lugaresi (Bologna), Christian Guilleminault (Stanford), and Colin Sullivan (Sydney). These individuals may be regarded as the modern equivalents of the “giants” referenced by Bernard of Char-

tres, upon whose shoulders contemporary scholars stand in order to see further and gain deeper insight.

William C. Dement, in placing the study of human sleep in a historical framework,² wrote:

“Obstructive sleep apnoea was discovered in Europe in 1965 by two separate groups, Gastaut et al³ and Jung and Kuhlo.⁴ Kuhlo et al⁵ are credited with performing the first tracheostomy with the intention of bypassing airway obstruction that occurred during sleep in the upper airway of these very obese patients” ... “It is not clear what would have happened if an Ital-

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ian neurologist, Elio Lugaresi, had not become very interested in obstructive sleep apnoea which he called “hypersomnia with periodic breathing”. He pursued the problem with unusual zeal, although he did not publish his seminal study⁶ documenting an association between snoring and hypertension until 1975”.

The aim of this study is to highlight the contributions of Elio Lugaresi and his team at the University of Bologna to the establishment of Sleep Medicine, particularly through the promotion of polysomnography, which represented a breakthrough in the measurement of sleep.

Elio Lugaresi, the man and the scientist

Elio Lugaresi (Figure 1) was born in Castiglione di Cervia on 1 July 1926. He studied Medicine at the University of Bologna, where he developed a strong interest in Physiology and Neurology. His subsequent career unfolded primarily in Bologna, with a notable training period in 1956 and 1957 under Henri Gastaut in Marseille. In Bologna, he organised a pioneering sleep laboratory and established a dedicated sleep unit. He enjoyed a distinguished academic career, ultimately becoming a Full Professor of Neurology and serving as Director of the Institute of Clinical Neurology, the Postgraduate School in Neurology, and the School of Neurophysiopathology Technicians. Although he retired in 2001, he continued his scholarly and clinical



Figure 1. Professor Elio Lugaresi.

Photograph by: Paolo Ferrari

Archivio Ferrari Genus Bononiae

“Collezioni d’Arte e di Storia della Fondazione Cassa di Risparmio in Bologna”

work as Emeritus Professor until his death in Bologna on 22 December 2015.

Lugaresi was one of the giants who transformed Sleep Medicine into one of the most dynamic fields of research and treatment (Table 1). His contributions are reflected in 404 publications in peer-reviewed journals, a list of books (Table 2) that garnered 25,805 citations, a D-index of 91, and an array of prestigious awards (Table 3). His worldwide recognition is further underscored by his roles in scientific societies and esteemed memberships (Table 4).

Contributions of the Lugaresi Group to Sleep Medicine

Fabio Cirignotta highlighted the achievements of the Lugaresi group and pointed out that they were the first to document the major fluctuations in pulmonary and systemic arterial pressure during obstructive apnoeas and to highlight the close physiopathogenetic connections between snoring and obstructive apnoeas.⁷

“This period also saw the first studies on Restless Legs Syndrome and Periodic Limb Movements at the Neurology Institute, followed by research spanning the whole field of sleep disorders. One of the most promising fields of research proved to be the epidemiological studies on insomnia, parasomnia and snoring culminating in an international Workshop that took place in Milano Marittima in 1982”.⁷⁻¹²

In his CV, available at the University of Bologna, Elio Lugaresi wrote:

“The first polysomnographic investigation into Restless Legs Syndrome demonstrating the presence of involuntary periodic limb movement termed “Nocturnal myoclonus”.

“Pioneering research into snoring and sleep apnoea: (a) The hemodynamic and ventilatory effects of obstructive apnoeas. (b) The clinical and physiopathological link between snoring and apnoea syndrome (c) Snoring as a risk factor for cardiovascular disease”.

The Historic 1972 Rimini Congress

In 1972, Elio Lugaresi and his group organised a Symposium on Hypersomnia and Periodic Breathing in Rimini, which brought together many world-renowned investigators to discuss the polygraphic aspects of sleep. Papers of the congress were published in the *Bulletin de Physiopathologie Respiratoire*. Lugaresi highlighted data on “Polygraphic Aspects of Sleep Disorder in Man”,¹³ stressing the importance of overnight polygraphic studies involving the simultaneous electroencephalogram (EEG), electrooculogram (EOG), and electromyogram (EMG)

Table 1. Elio Lugaresi, short biography.

• Born in Castiglione di Cervia on 1 July 1926.
• Studied Medicine at the University of Bologna (1946-1952).
• Residency in Neurology at the University of Bologna (1952-1958).
• Training at the EEG Laboratory of Henri Gastaut in Marseille (1956-1957).
• Organisation of the Sleep Laboratory at the University of Bologna.
• Chief of Inpatient Neurology Service (1958-1968).
• Director Laboratory of Sleep Disorders at the University of Bologna. Among his associates Giorgio Coccagna.
• Organiser at Rimini of an outstanding congress on Hypersomnia and Periodic Breathing (1972).
• Full Professor of Neurology at the University of Bologna in 1975.
• Director of the Institute of Clinical Neurology (1975-1998).
• Director of the School of Neurophysiopathology Technicians (1975-1998).
• Director of the Postgraduate School of Neurology (1977-1999).
• Retirement from university 2001.
• Professor Emeritus at the University of Bologna 2001.
• Death in Bologna on 22 December 2015.

recordings. Lugaresi's group also provided data on "Continuous Recordings of the Pulmonary and Systemic Arterial Pressure During Sleep in Syndromes of Hypersomnia with

Table 3. Elio Lugaresi list of awards.

• 1983: American Association of Sleep Disorders.
• 1995: Ottorino Rossi Award for Neurology of "C. Mondino" Foundation University of Pavia.
• 1996: Pisa Sleep Award of the American Academy of Neurology.
• 1997: Potamkin Prize of the American Academy of Neurology.
• 1998: Giuseppe Moruzzi Award of the World Federation of Clinical Neurophysiology.
• 2003: Founder of the field of modern sleep research of the Sleep Research Society.
• 2003: William C. Dement Academic Achievement Award of the American Academy of Sleep Medicine.
• 2004: «Interbrew – Baillet Latour de la Santé» Foundation Prize.
• 2008: "Giuseppe Caruso" Award of the Italian Society of Clinical Neurophysiology.
In recognition of his leadership the World Association of Sleep Medicine established the Elio Lugaresi Award for Sleep Medicine.

Table 2. Books authored and coauthored by Elio Lugaresi.

• Lugaresi P, Sandri M. Aspetti clinici delle Epidemie. Bologna, Aulo Gaggi Editore, 1959.
• Gastaut H, Lugaresi E, Berti Ceroni G and Coccagna G. (Eds.), The Abnormalities of Sleep in Man. Bologna, Aulo Gaggi Editore, 1968.
• Lugaresi E, Pazzaglia P, Tassinari CA, (Eds). Evolution and Prognosis of Epilepsies. Bologna, Aulo Gaggi Editore, 1972.
• Lugaresi P, Coccagna G. I disturbi del sonno. Bologna, Aulo Gaggi Editore 1976.
• Lugaresi E, Coccagna G and Mantovani M. Hypersomnia with Periodic Apneas. New York, Plenum Press 1977.
• Guilleminault C, Lugaresi E. (Eds). Sleep/Wake disorders: natural history, epidemiology, and long-term evolution. New York, Raven Press, 1983.
• Andermann F, Lugaresi E. (Eds.) Migraine and Epilepsy. Boston, Butterworths, 1987.
• Guilleminault C, Lugaresi E, Montagna P, Gambetti P. (Eds.) Fatal Familial Insomnia. Inherited prion diseases, sleep, and the thalamus. New York, Raven Press, 1994.

Periodic Breathing".¹⁴ They showed that in hypersomniac hypertensive patients, there was an increase in systemic and pulmonary arterial pressure, which was highest at the end of each apnoea. The pressure rose progressively during the successive stages of slow sleep and increased further during REM sleep. Changes in heart rate paralleled those in pressure values. All patients developed severe

Table 4. Recognition of Lugaresi success in science.

Presidency of Italian Scientific Societies
• Italian EEG Society (1969-1972).
• Italian League against Epilepsy (1972-1976).
• Italian Society of Neurology (1984-1987).
• Italian Association of Sleep Medicine (1990-1994).
• Italian College of Neurologists (1996-2000).
Membership in Medical and Scientific Societies
• Ambassador for Epilepsy for the International League Against Epilepsy.
• Corresponding Member American Neurological Association.
• Honorary Member of the Association for Sleep Disorders Centres.
• Honorary Member German EEG Society.
• Honorary Member French Society of Neurology.
• Honorary Member Spanish League against Epilepsy.
• Honorary Fellow of the American of Sleep Disorders Association.

acidosis with hypoxia and hypercapnia, which significantly increased from wakefulness to slow sleep and from slow sleep to REM sleep.¹⁴

On the pioneering work of the Lugaresi Group in Bologna

“A pioneering team of anaesthesiologists, cardiologists, and pneumologists began working in Bologna, leading to consistent results in the field by the late 1960s”.¹⁵

“An old electroencephalograph was moved each night from the normal laboratory to a larger room where patients could sleep in comfortable beds. In this setting, a doctor or a technician, illuminated only by the weak light of a flashlight, could perform periodic measurements.

Among those pioneering spirits who dedicated themselves to this research were Pierluigi Gambetti, now Professor of Neuropathology in Cleveland, and Domenico Gambi, Director of the Neurological Clinic of Chieti. However, it was Giorgio Coccagna who displayed the greatest enthusiasm and ingenuity; without his dedication, it is likely that the sleep laboratory would never have come to fruition. Two young technicians, Pierino Pollini and Francesco Negrini, accepted the challenging routine of night recordings, driven not only by their sense of professional solidarity but perhaps also by their attraction to the originality of the work, which fuelled our shared enthusiasm”.¹⁶

Paola Verucci Coccagna, anaesthesiologist trained to monitor vital signs, played a leading role in the group. She was instrumental in the measurements of systemic and pulmonary arterial pressure and blood gases.

“At what was to become an historic event, the 1972 Congress held in Rimini, the group presented a full spectrum of cardiocirculatory and ventilatory changes occurring during sleep in obstructive apnoea syndrome. A mistake was the unfortunate name given to the syndrome Hypersomnia with Periodic Breathing, which, in fact, was subsequently changed to the more effective term of Obstructive Sleep Apnoea Syndrome (OSAS). It was the first time that the data from Bologna polysomnographic studies had been made available, they were to become a familiar sight in sleep laboratories all over the world documenting the important ventilatory and haemodynamic effects of obstructive apnoeas”.¹⁵

Major contributions to Sleep Medicine

A study¹⁴ was performed on 10 patients with diurnal hypersomnia and periodic respiration with apnoea during sleep.

Five patients had high blood pressure. Simultaneous overnight recordings were made of various parameters, including electrocardiogram (ECG), cardi tachygram, electroencephalogram (EEG), electromyogram (EMG), electrooculogram of the mylohyoid muscle, thoracic respiratory movements, nasal and oral respirograms, pulmonary arterial pressure, systemic arterial pressure, and blood gases, recorded when ventilation was restored and during subsequent apnoeas. Patients were studied during wakefulness as well as during sleep stages 1, 2, 3-4, and REM sleep. The results showed that pulmonary arterial pressure increased from sleep stage 1 to sleep stage 3-4 and peaked during REM sleep.

Systemic arterial pressure increased progressively from wakefulness to stages 3-4 and peaked during REM sleep. Blood gas analyses revealed acidosis, hypercapnia, and hypoxia, which worsened from wakefulness to REM. In patients with hypersomnia and periodic breathing, performing tracheostomy effectively abolished diurnal somnolence and significantly reduced the number of apnoeas. Additionally, both pulmonary and systemic arterial pressures normalised, along with the resolution of acidosis, hypoxia, and hypercapnia.¹⁷

A study investigating overnight changes in systemic blood pressure compared 8 heavy snorers to 8 normal subjects.⁶ The results demonstrated that, in normal subjects, blood pressure decreased significantly and progressively from wakefulness to stages 1, 2, and 3-4. During REM sleep, blood pressure values were found to be similar to those in stage 2. In contrast, heavy snorers exhibited a progressive and significant increase in systolic blood pressure from wakefulness to REM sleep. Diastolic blood pressure also showed a similar, albeit less pronounced, upward trend from the slower sleep stages to REM.

Epidemiological studies on snoring

Studies by Lugaresi et al. have indicated that heavy and habitual snoring may adversely affect cardiac and circulatory function. To investigate whether these are a predisposing factor for hypertension and cardiocirculatory diseases, Lugaresi sought support from national funding agencies for such a study, but funding was not made available. Nonetheless, he received a personal contribution from his friend and colleague Bill Dement, who was the first to document overnight changes in sleep.

The study was conducted in the Republic of San Marino, which has a population of approximately 20,000 people. All citizens have free access to health-care, and their medical data is recorded in personal files. A total of 5,713 individuals were examined. Among the population, 13.8% were identified as habitual snorers, with a higher prevalence in males than

in females. Hypertension was observed in 2.8% of individuals aged 21-40, in 10.4% of those aged 41-60, and in 27.6% of individuals aged 61-80. The study found that snorers were more prone to high blood pressure. These preliminary findings support the notion that heavy and habitual snorers are at an increased risk of cardiovascular disease.¹⁸

Fatal Familial Insomnia

Fatal Familial Insomnia, as described by Lugaresi et al. in 1986 in *The New England Journal of Medicine*, is a disease characterised by an inability to sleep, dysautonomia, and motor disturbances. These motor disturbances include myoclonus, ataxia, and pyramidal signs.¹⁹

Seven years later, Lugaresi et al. were able to distinguish Fatal Familial Insomnia (FFI) from Sporadic Fatal Insomnia in *Lancet Neurology*.²⁰ In the meantime, data from Goldbarb et al. demonstrated in *Science* that Fatal Familial Insomnia and a subtype of familial Creutzfeldt-Jakob Disease (CJD) are both characterised by a mutation at codon 178 (Asn178) of the prion protein gene.²² FFI and the familial CJD subtype segregate with different genotypes determined by the Asn178 mutation and the methionine-valine polymorphism at codon 129. Specifically, the Met129, Asn178 allele is associated with FFI, while the Val129, Asn178 allele is associated with familial CJD. Thus, two distinct disease phenotypes are linked to a single pathogenic mutation influenced by a common polymorphism.²¹

Lugaresi's Method

The method Elio Lugaresi adopted was outlined by his associates in the obituary published in *Sleep Medicine* 2016.

“Throughout his career Elio Lugaresi showed a remarkable ability to recognise what was important in his data, make the discovery and then, instead of passing to another topic, create a sustained research program. This is repeatedly exemplified in his series of papers on Nocturnal Frontal Lobe Epilepsy and Fatal Familial Insomnia. The scientific method he passed on to his neurology research group was based on the observation and consequent description and analysis of clinical phenomenon's. After that, he always developed a complex reasoning, accompanied by a cultured and creative explanation of the patients' disease.”²²

There may be several reasons for why his studies initially failed to promote immediate interest in addressing a leading health problem:

“The publication by Coccagna et al. on systemic and pulmonary surges of blood pressure during sleep in Pickwickian patients was cited 193 times. However, as explained to me by Elio Lugaresi, these papers were not published

in leading medical journals such as *The New England Journal of Medicine*, *The Lancet*, or *The British Medical Journal*, which limited their potential to impact everyday medical practice. So, it is evident that the journals chosen to convey the findings of the Lugaresi group were too specialized, to inform the broader scientific community of a breakthrough (23).”

Thoughts on Professor Elio Lugaresi's contributions to Sleep Medicine

“Everything started thanks to my relationship with Henry Gastaut. When American colleagues began publishing on polysomnography, Gastaut advised my collaboration with Tassinari to adopt the method. Together with Coccagna and a team of technicians, we began overnight recordings in an unconventional way, utilizing an old encephalograph set up in the nearby bathroom, while the recordings were conducted in an adjacent room. Everything was quite artisanal during those early days. However, we quickly realized how fortunate we were, as each recording unveiled new discoveries. Sleep had not been extensively studied before, and we had ventured into a ‘terra incognita.’

“Our research approached the subject in a Renaissance manner, centred around the patient.”

“The investigator is the poet of reality. Intuition serves as the fundamental act of discovery. The new can only be uncovered by understanding the old, yet it is culture that allows us to recognize and embrace the new.”

“Regarding Sleep Disorders as an independent specialty, I am open to the development of specialties as long as they do not become isolated ‘ivory towers.’ I am cautious about the idea of isolated Sleep Medicine. I am uncertain whether, in the future, the medical field will witness further subdivisions.”

“The future might drive us there. Nowadays Sleep Medicine is one of the most dynamic and active branches of Medicine”. “I hope to be remembered for my contributions to the studies on sleep medicine.”²⁴

Lugaresi preparing for retirement

On the day of his retirement, Marina Amaduzzi, a journalist of *la Repubblica*, [the second most important Italian daily] asked him about his plans for the future.

He answered: “I’m stepping out of my role, but I will continue to work.” After all, at 90 years of age, Montanelli [influential columnist at *Il Corriere della Sera*] continues to write and Michelangelo painted the Pietà in the last years of his life. If the brain continues to function, I will continue

to work. I am also ready for the end; we must accept that life has its own arc. Montaigne said that philosophising is learning to die: our life is not eternal, but its limit is not due to chronological age or the roles one plays”.

“We were lucky and achieved important results, although there were things I could have done better. We made great discoveries about snoring and sleep apnoea, but they have not been disseminated in the right way, because we published them in the wrong journals. However, I am extremely satisfied, because we worked in difficult conditions”.²⁵

The role of Lugaresi in the advent of modern Sleep Medicine

The problem of sleep has occupied human thought since Western Antiquity (26), with references traceable as far back as the Homeric poems (c. 750-723 BCE). In the *Iliad* (XIV, 270), the God of Sleep is said to reside on the Isle of Lemnos, where even Juno journeyed to implore him - “the brother of Death” - to lull Zeus into slumber.

For Heraclitus (Table 5) of Ephesus (*floruit* 504-501 BCE), “in sleep, the sense channels are closed, preventing the mind from connecting with what lies outside”. For Alcmaeon of Croton (510-440 BCE) “Sleep is caused by the confinement of blood to larger blood-vessels, whereas waking is brought about by re-diffusion”. For Diogenes of Apollonia (*floruit* 440-430 BCE) “Sleep is caused by moistening of the air-soul”. According to Aëtius “Empedocles of Akragas (492-432 BCE) thinks that sleep depends on a moderate cooling of the warmth in the blood, death by contrast is a total cooling. ...sleep depends on the separation of the element fire”. For Anaxagoras (500/497-428 BCE) sleep was a process unrelated to the soul and entirely due to the body temperature, and therefore it could be considered as “exhaustion of physical energy”.

For Plato (429-347 BCE) “Sleep is useful to the body.

One should sleep a little, an indispensable minimum. Only those lacking responsibility sleep a lot. The master and the mistress of the house should sleep a little. A long sleep is not appropriate, neither for law of nature nor for the body, nor the soul, nor to the actions of body and soul (*Laws VII*). “Who sleeps is of no value, as a dead body” (*Laws, VII*).

Aristotle (384-322 BCE) wrote extensively in *On sleep and waking* that is part of *Small Essays on Philosophy of Nature*. “Sleep and waking belong to the same part of the animal since they are antagonists; sleep appears as a lack of waking and waking as a deprivation of sleep. In fact, in nature as everywhere contraries appear within the same receptor and constitutes its affection (*On Sleep and Wakings* 453b 25). The sleep is an affection of the perceptive part, like a kind of enchainment and immobility, so that it is necessary that all that sleeps entails a perceptive part” (*On Sleep and Wakings* 454 b 15).

Sleep follows alimentation, which generates blood that then diffuses throughout the entire body. During the process of digestion, evaporation occurs, cooling the blood before it is sent to the brain. As a result, the head becomes cold and heavy. The blood then returns to the heart, where it pushes the natural heat characteristic of that region, leading the animal to sleep.

Sleep Medicine is now a clinical science that plays a crucial adjunct role in the management of nearly every disease. The problem of sleep disorders has occupied humankind since Antiquity. However, it was only 96 years ago that technological advancements made it possible to quantify sleep disorders in humans, marking a significant milestone in the field.²⁷ Berger’s study,²⁸ conducted 96 years ago, was the first (Table 6) in a series of significant advancements in the field: (a). The identification of NREM

Table 5. Ancient authors mentioning sleep disorders.

Author	Date	Works
Homer	750-723 BCE	<i>Iliad</i> XIV, 270
Hesiod	born c 700 BCE	<i>Theogony</i> 211-212
Heraclitus	floruit 504 - 501 BCE	<i>Stromata</i> , Fragment 21 of Clemens Alexandrinus
Diogenes	floruit 440 - 430 BCE	Diehl-Kranz, <i>Die Fragmente der Vorsokratiker</i> .
Alcmaeon	510? - 440? BCE	Diehl-Kranz, <i>Die Fragmente der Vorsokratiker</i> .
Anaxagoras	507/497 - 428 BCE	Diehl-Kranz, <i>Die Fragmente der Vorsokratiker</i> .
Empedocles	492 - 432 BCE	<i>Purifications</i> , Diehl-Kranz, <i>Die Fragmente der Vorsokratiker</i>
Plato	429 - 347 BCE	<i>Laws VII</i> , 808b6-c2, 808b5-6
Aristotle	384 - 322 BCE	<i>On Sleep and Wakings</i>

Table 6. The advent of Sleep Medicine.²⁷

Year	Ref.	Discovery
1929	28	Electroencephalogram in humans
1937	29	NREM sleep
1953	1	REM sleep
1956	30	Obesity and hypoventilation
1957	31	4 stages of NREM and REM sleep
1960	32	Narcolepsy and early onset REM
1966	33	Pathology of Upper Way Collapse
1972	9	First systematic study on how systemic arterial pressure behaves during sleep in normal subjects
1972	14	Blood pressure changes went along changes in heart rate, breathing and oxygen saturation
1986	34	REM Sleep Behaviour Disorder
1993	35	High prevalence of Obstructive Sleep Apnoea in middle-aged population
2000	36	High prevalence of Restless Legs Syndrome

sleep²⁹; (b). The characterisation of REM sleep (1); (c).The link between Obesity and hypoventilation³⁰; (d).The identification of 4 stages of NREM and REM sleep³¹; (e).Narcolepsy and early onset REM³²; (f). The first systematic study on how systemic arterial pressure behaves during sleep in normal subjects⁹; (g).The demonstration that blood pressure changes went along changes in heart rate, breathing and oxygen saturation¹⁴; (h).The identification of the pathology of upper way Collapse³³; (i).The REM sleep behaviour disorder³⁴; (l). The demonstration of the prevalence of Obstructive Sleep Apnea in middle-aged population³⁵; (m). The demonstration that the prevalence of Restless Legs Syndrome is 10%³⁶. Notably, steps (g) and (h) were due to the genius and hard work of Lugaresi's group in Bologna.^{9,14} Those two studies gave the possibility to characterise sleep disorders at bedside.

Conclusion

As summarised by Schutz and Salzarulo “sleep medicine, which is a quite new medical field with a long clinical tradition, developed rapidly in the last three

decades of the 20th century” (37). There is no doubt that Lugaresi and his group have played a significant role in this exciting story.

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Warmest thanks are due to Alessandra Lugaresi Associate Professor, Department of Biomedical and Neuromotor Sciences at the University of Bologna, Director of the School of Specialization in Neurology for significant help in retrieving material of and about Elio Lugaresi, her father.

ΠΕΡΙΛΗΨΗ

Elio Lugaresi (1926-2015): Πρωτοπόρος στην ιστορία των διαταραχών ύπνου

De Santo Rosa Maria

Η ιστορία της έρευνας στις διαταραχές ύπνου ξεκίνησε με την emblematicή εργασία των Aserinsky και Kleitman το 1953 στο περιοδικό *Science*, με τίτλο «Regularly Occurring Periods of Eye Motility and Concomitant Phenomena». Ο τομέας αυτός εξελίχθηκε χάρη στη συνεισφορά πολλών σπουδαίων επιστημόνων, όπως οι Nathaniel Kleitman (Σικάγο), William C. Dement (Στάνφορντ), Henri Gastaut (Μασσαλία), Elio Lugaresi (Μπολόνια), Christian Guilleminault (Στάνφορντ) και Colin Sullivan (Σίδνεϊ).

Ο Elio Lugaresi (Castiglione di Cervia, 1 Ιουλίου 1926 – Μπολόνια, 22 Δεκεμβρίου 2015) ήταν ένας από αυτούς τους γίγαντες που μετέτρεψαν την Ιατρική του Ύπνου σε έναν από τους πιο δυναμικούς τομείς έρευνας και θεραπείας. Αποφοίτησε από το Πανεπιστήμιο της Μπολόνια το 1952. Κατά τη διάρκεια της ειδικότητάς του στη Νευρολογία στο ίδιο πανεπιστήμιο, εκπαιδεύτηκε στην πολυπνογραφία (PSG) υπό τον Henri Gastaut από το 1956 έως το 1957 στη Μασσαλία. Συνέδεσε τις κλινικές παρατηρήσεις με τα δεδομένα της πολυπνογραφίας και, επιστρέφοντας στην Μπολόνια, άρχισε να συνεργάζεται με τον Giorgio Coccagna και άλλους για την καταγραφή πολυπνογραφικών δεδομένων χρησιμοποιώντας ένα πρωτόγονο ηλεκτροεγκεφαλογράφο.

Η ομάδα παρήγαγε πρωτοποριακές εργασίες για: (i) τις πνευμονικές πιέσεις, την αρτηριακή πίεση, τα αέρια αίματος, την αναπνοή και τον ύπνο· (ii) το σύνδρομο ανήσυχων άκρων και τον μυόκλονο· (iii) το ροχαλητό και την υπέρταση, που οδήγησαν στην αναγνώριση της υπνικής άπνοιας ως παράγοντα κινδύνου για καρδιαγγειακή νόσο· και (iv) την Θανατηφόρο Οικογενή Αϋπνία. Το 1967, οργάνωσαν το Πρώτο Διεθνές Συνέδριο Ιατρικής του Ύπνου στη Μπολόνια.

Όπως δήλωσε σε συνέντευξή του στην Ιταλική Εταιρεία Ιατρικής Ύπνου, ο Lugaresi εμπνεύστηκε από την αναγεννησιακή ιδέα ότι όλη η γνώση πρέπει να πηγάζει από την παρατήρηση της ανθρώπινης ύπαρξης. Ακόμη και κατά τα έτη του ως ομότιμος καθηγητής, παρέμεινε παραγωγικός, συγγράφοντας περισσότερες από 500 εργασίες και κεφάλαια, τα οποία του απέφεραν μια μακρά λίστα βραβείων και τιμητικών διακρίσεων. Ο William C. Dement, αναφερόμενος στην πρωτοτυπία του έργου του Lugaresi, δήλωσε: «Δεν είναι σαφές τι θα είχε συμβεί αν ένας Ιταλός νευρολόγος, ο Elio Lugaresi, δεν είχε δείξει τόσο μεγάλο ενδιαφέρον για την αποφρακτική υπνική άπνοια».

Λέξεις Κλειδιά: Elio Lugaresi, πολυπνογραφία, πνευμονική πίεση, αρτηριακή πίεση, αναπνοή, αέρια αίματος, θανατηφόρος οικογενής αϋπνία

REFERENCES

1. Aserinsky E, Kleitman N. Regularly occurring periods of eye motility, and concomitant phenomena, during sleep. *Science*. 1953 Sep 4;118(3062):273-4. doi: 10.1126/science.118.3062.273. PMID: 13089671.
2. Dement WC. The study of human sleep: a historical perspective. *Thorax*. 1998 Oct;53 Suppl 3: S 2-7. PMID: 10193352; PMCID: PMC1765910.
3. Gastaut H, Tassinari CA, Duron B. Etude polygraphique des manifestations épisodiques (hypniques et respiratoires), diurnes et nocturnes, du syndrome de Pickwick [Polygraphic study of diurnal and nocturnal (hypnic and respiratory) episodal manifestations of Pickwick syndrome]. *Rev Neurol (Paris)*. 1965 Jun;112(6):568-79. French. PMID: 5856212.
4. Jung R, Kuhlo W. Neurophysiological studies of abnormal night sleep and the Pickwickian syndrome. *Prog Brain Res*. 1965; 18:140-59. doi: 10.1016/s0079-6123(08)63590-6. PMID: 14329033.
5. Kuhlo W, Doll E, Franck MD. Successful management of Pickwickian syndrome using long-term tracheostomy. *Dtsch Med Wochenschr* 1969; 94:1286-90. doi: 10.1055/s-0028-1111209. PMID: 5771076.
6. Lugaresi E, Coccagna G, Farneti P, Mantovani M, Cirignotta F. Snoring. *Electroenceph Clin Neurophysiol* 1975; 19: 59-64. doi.org/10.1016/0013-4694(75)90127-3. PMID: 50200.
7. Cirignotta F, Lugaresi E. and the Italian School. The Founders of the European Sleep Research and Sleep Medicine. In Bassetti C.L. (Ed.), Knobl B, Schulz H (co-eds), *European Sleep Research Society 1972 – 2012. 40th Anniversary of the ESRS*.
8. Guilleminault C, Lugaresi E, editors. *Sleep/Wake Disorders: Natural History, Epidemiology and Long - Term Evolution*. New York, Raven Press, 1983.
9. Coccagna G, Mantovani M, Brignani F, Manzini A, Lugaresi E. Laboratory note. Arterial pressure changes during spontaneous sleep in man. *Electroencephalogr Clin Neurophysiol* 1971; 31: 277-281. doi: 10.1016/0013-4694(71)90098-8. PMID: 4105876.
10. Lugaresi E, Coccagna, Mantovani M, Lebrun R. Some periodic phenomena arising during drowsiness and sleep in man. *Electroencephalogr Clin Neurophysiol*. 1972 Jun;32(6):701-5.

- doi: 10.1016/0013-4694(72)90106-x. PMID: 4121520.
11. E Lugaresi E, Coccagna G, Berti Ceroni G. Syndrome de Pickwick et syndrome d'hypoventilation alveolaire primaire. *Acta Neurol Psychiatr Belg*.1968 Jan;68(1):15-25. PMID: 4301868.
 12. Coccagna G, Lugaresi E. Restless legs syndrome and nightly myocloni. *EEG EMG Z Elektroenzephalogr Elektromyogr Verwandte Geb*. 1978 Sep;9(3):155-60. PMID: 100310.
 13. Lugaresi E. Aspects polygraphiques du sommeil chez l'homme. *Bull Physiopathol Resp* 1972;8: 1071 -1074. PMID: 4348635.
 14. Coccagna G, Mantovani M, Brignani F, Parchi C, Lugaresi E. Enregistrement continu de la pression arterielle pulmonaire et systemique pendant le sommeil dans les syndromes d'hypersomnie avec respiration periodique. *Bull Physio-path Resp* 1972; 8: 1159-1172. PMID: 4348639.
 15. Coccagna G, Lugaresi E. Haemodynamics during sleep: old results and new perspectives. *Sleep Res*. 1995 Jun;4(S1):2-7. doi: 10.1111/j.1365-2869.1995.tb00178.x. PMID: 10607165.
 16. Lugaresi E: Preface to G. Coccagna, *Il sonno e i suoi disturbi: Fisiopatologia e Clinica*. Piccin Nuova Libreria, Padova, 2001.
 17. Coccagna G, Mantovani M, Brignani F, Parchi C, Lugaresi E. Tracheostomy in hypersomnia with periodic breathing. *Bull Physiopathol Respir (Nancy)*. 1972 Sep-Oct;8(5):1217-27. PMID: 4348640.
 18. Lugaresi E, Cirignotta F, Coccagna G, Piana C. Some epidemiological data on snoring and cardiocirculatory disturbances. *Sleep*. 1980;3(3-4):221-4. doi: 10.1093/sleep/3.3-4.221. PMID: 7221330.
 19. Lugaresi E, Medori R, Montagna P, Baruzzi A, Cortelli P, Lugaresi A, et al. Fatal Familial Insomnia and dysautonomia with selective degeneration of thalamic nuclei. *N Engl J Med*. 1986 Oct 16;315(16):997-1003. doi: 10.1056/NEJM198610163151605. PMID: 3762620.
 20. Montagna P, Gambetti P, Cortelli P, Lugaresi E. Familial and sporadic fatal insomnia. *Lancet Neurol*. 2003 Mar;2(3):167-76. doi: 10.1016/s1474-4422(03)00323-5. PMID: 12849238.
 21. Goldfarb LG, Petersen RB, Tabaton M, Brown P, LeBlanc AC, Montagna P, et al. Fatal familial insomnia and familial Creutzfeldt-Jakob disease: disease phenotype determined by a DNA polymorphism. *Science*. 1992 Oct 30;258(5083):806-8. doi: 10.1126/science.1439789. PMID: 1439789.
 22. Baruzzi A. In memoriam: Elio Lugaresi, MD (July 1, 1926 - December 22, 2015) *Clinical Neurophysiology* 127 (2016) 2711-12. doi.org/10.1016/j.clinph.2016.03.003. PMID: 27198959.
 23. Lavie P. Who was the first to use the term Pickwickian in connection with sleepy patients? History of sleep apnoea syndrome *Sleep Med Rev*. 2008 Feb;12(1):5-17. doi: 10.1016/j.smrv.2007.07.008. PMID: 18037311.
 24. Sonnomed. [Internet]. Available from: https://www.sonnomed.it/wpcontent/uploads/2013/10/SONNOMED-1_2008.pdf, accessed September 12,2024.
 25. Amaduzzi M. Io, una vita d'insonnia. *Archives, la Repubblica* 2000; Aug 9.
 26. De Santo RM, De Santo NG. Sleep and dreams in Western Antiquity, In . Barret D and McNamara P, editors. *Encyclopedia of Sleep and Dreams*, Vol. 2. Santa Barbara: Greenwood p.609-644.
 27. Auerbach S. Brief History of Sleep Medicine in Barret D and McNamara P editos. *Encyclopedia of Sleep Medicine* Vol. I, Santa Barbara. Greenwood, 20012; p.104-109.
 28. Berger H. Über das Elektrenkephalogramm des Menschen. *Archiv für Psychiatrie und Nervenkrankheiten* 1929; 97: 6-26.
 29. Loomis AL, Harvey EN, Hobart GA. Cerebral states during sleep as studies by human brain potentials. *J Exp Psychol* 1937;21: 127-144. doi.org/10.1037/h0057431.
 30. Bickelmann AG, Burwell CS, Robin ED, Whaley RD. Extreme obesity associated with alveolar hypoventilation; a Pickwickian syndrome. *Am J Med*. 1956 Nov;21(5):811-8. doi: 10.1016/0002-9343(56)90094-8. PMID: 13362309.
 31. Dement W, and Kleitman. Ciclyc variations in EEG during sleep and their relation to eye movements, body motility and dreaming. *Electroencephalogr Clin Neurophysiol* 1957;9:673-680. doi: 10.1016/0013-4694(57)90088-3. PMID: 13480240.
 32. Vogel G. Studies in the psychophysiology of dreams. III: The dream of narcolepsy. *Arch Gen Psychiatry* 1960; 3: 421-428. doi: 10.1001/archpsyc.1960.01710040091011. PMID: 1.
 33. Gastaut H, Tassinari CA, Duron B. Polygraphic study of the episodic diurnal and nocturnal (hypnic and respiratory) manifestations of the Pickwick syndrome. *Brain Research* 1966;2:167-186. doi: 10.1016/0006-8993(66)90117-x. PMID: 5923125.3781811.
 34. Schenck CH, Bundlie SR, Ettinger MG, Mahowald MW. Chronic behavioral disorders of human REM sleep. A new category of parasomnia. *Sleep*; 1986:293-308. doi: 10.1093/sleep/9.2.293. PMID: 3505730.
 35. Young T, Palta M, Dempsey J, Skatrud J, Weber S, Badr S. The occurrence of sleep-disordered breathing among middle-aged adults. *N Engl J Medicine* 1993; 328: 1230-1235. doi: 10.1056/NEJM199304293281704. PMID: 8464434.
 36. Philips B, Young T, Finn L, Asher R, Hening WA, Purvis C. Epidemiology of Restless legs symptoms in adults. *Arch Intern Medicine* 2000;160:(14)2137-2141. doi: 10.1001/archinte.160.14.2137. PMID: 10904456.
 37. Schutz H and Salzarulo P. The Development of Sleep Medicine: A Historical Sketch. *J Clin Sleep Med* 2016;15;12(7):1041-1052 doi: 10.5664/jcsm.5946. PMID: 27250813.

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