Final Defense

PhD Course in Bioengineering - Final Thesis Defense

PhD Candidate: **Valeria Ottaviani**

Advisor: Prof. Raffaele Dellacà

08.11.2021
h. 15:30
@ Microsoft Teams
Aula Alario Bld n. 21

Thesis: IMPROVING RESPIRATORY SUPPORT OF PRETERM NEWBORNS BY BEDSIDE CHARACTERIZATION OF LUNG MECHANICS AND RESPIRATORY CONTROL

COMMITTEE MEMBERS

Prof. MD, PhD Daniele De Luca
Chef de Service - Division Chief Professor of Neonatology President Elect - European Society for Pediatric and Neonatal Intensive Care Editor - European Journal of Pediatrics
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Associate Professor, Senior Consultant in Neonatology Department of Women's and Children's Health Uppsala University Children's Hospital

Prof. Elena De Momi
Politecnico di Milano, Milano, Italy

SCHEDULE OF THE DAY

15:30 - 15:45	Committee Meeting
15:45 - 16:45	Thesis presentation - Discussion
16:45 - 17:00	Committee meeting
17:00	Award Ceremony

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Final Defense

PhD student: VALERIA OTTAVIANI – XXXIII Cycle

Thesis title: IMPROVING RESPIRATORY SUPPORT OF PRETERM NEWBORNS BY BEDSIDE CHARACTERIZATION OF LUNG MECHANICS AND RESPIRATORY CONTROL

Advisor: Prof. Raffaele Dellacà

Abstract:
Premature birth implicates that the last stages of lung development, which generally take place in utero, occur after birth and under very different environmental conditions, requiring rapid adjustment of cardio-respiratory system to permit the newborn to survive. For this reason, preterm babies are prone to respiratory system pathologies, often requiring respiratory support. Since the immaturity of the respiratory system of preterm babies makes them more prone to lung damage, the selection of the best-suited ventilation strategy is crucial from the first minute of life. Personalized or individualized medicine has become an increasingly used approach in adult and pediatric research. A combination of clinical measurements able to provide information about respiratory system mechanics, asynchronies of the thoraco-abdominal compartment, muscular activity (and fatigue), and central breathing generator condition may help clinicians optimize patient treatment. The aim of this Ph.D. project is to improve the management of non-invasive ventilation in preterm infants. Specific objectives of my Ph.D. project include i) the development of novel tools for the assessment of different aspects of the respiratory function in preterm newborns receiving non-invasive respiratory ventilation, which may help disentangle the complexities of the pathophysiological mechanisms resulting in inadequate gas exchange, ii) the definition of criteria for surfactant administration based on the direct assessment of lung volume recruitment; iii) the assessment of the short-term physiological effects of a non-invasive ventilation strategy synchronized with and proportional to the neural breathing activity. Specifically, I developed a device to collect long time series of ventilatory parameters enabling the assessment of long-term correlation properties of the central breathing pattern generator; a device for the simultaneous monitoring of lung mechanics and diaphragm activity during preclinical studies; an innovative contactless method for monitoring breathing pattern and thoraco-abdominal asynchronies. I also collaborated with producers of neonatal mechanical ventilators to integrate measurements of respiratory system impedance by forced oscillation technique (FOT) in a commercial bedside device, focusing particularly on testing and improving the accuracy of the measurements. Finally, I evaluated the accuracy evaluation of mechanical ventilators available at the bedside in real-word conditions. The developed systems have been evaluated in-vitro, on animal model, or in-vivo and proved to be accurate. Moreover, I participated in two clinical studies during which the developed systems have been used. The first study exploited FOT measurements to identify early surfactant needs in preterm infants; the study is concluded and has been successfully enrolled 59 preterm infants, finding that measurement of respiratory reactance at the bedside may be used in combination with clinical criteria to improve surfactant administration. The second study aimed to compare the effects of two ventilation modes on preterm infants' breath during non-invasive ventilation. During this study, breathing signals, thoraco-abdominal movements, lung mechanics, and breathing pattern variability have been studied together; the study is almost concluded, and we enrolled 19 infants so far.