



UNIVERSITÀ  
DEGLI STUDI DI MILANO-BICOCCA

## SYLLABUS DEL CORSO

### Internship in Cardiovascular Pathophysiology and Hemodynamics

2425-3-H4102D119

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#### Aims

This internship aims at exposing students to a pathophysiological approach and understanding of common cardiological symptoms and conditions, such as dyspnea, heart failure, valvular heart disease, pulmonary hypertension.

In particular, it aims at:

1. providing the basis for understanding cardiopulmonary exercise test responses in healthy and disease states
2. exposing the student to 2nd and 3rd level cardiopulmonary exercise test (combined with exercise stress echocardiography and invasive cardiopulmonary exercise test)
3. acquiring the skills for autonomous interpretation and report of cardiopulmonary exercise test and right heart catheterization

#### Contents

Cardiopulmonary exercise testing: how to perform and interpret it, in unexplained dyspnea, heart failure, valvular heart disease, pulmonary hypertension.

Exercise right heart catheterization: how to perform and interpret it, in unexplained dyspnea, heart failure, valvular heart disease, pulmonary hypertension.

#### Detailed program

The student will assist to sessions of cardiopulmonary exercise test and exercise right heart catheterization.

Importance will be given to patients' preparation, contraindications and indications to these exams, pivotal parameters under analysis (including oxygen consumption, carbon dioxide production, exercise hyperventilation; filling pressures, pulmonary pressures, cardiac output) as well as to their clinical and pathophysiological meaning. The student will be shown how to interpret these exams in different clinical and pathophysiological conditions (unexplained dyspnea, heart failure, valvular heart diseases, pulmonary hypertension). The student will learn how to perform and interpret these exams, with a final assessment consisting in autonomous interpretation of cardiopulmonary exercise test and exercise right heart catheterization.

## **Prerequisites**

Notions of physiology and cardiology

## **Teaching form**

Non frontal lectures.

Attendance to outpatient and inpatient activity of cardiopulmonary exercise test and exercise right heart catheterization.

Attendance and involvement in interpretation of cardiopulmonary exercise test and exercise right heart catheterization.

## **Textbook and teaching resource**

Maron BA, Cockrill BA, Waxman AB, Systrom DM. The invasive cardiopulmonary exercise test. *Circulation*. 2013 Mar 12;127(10):1157-64. doi: 10.1161/CIRCULATIONAHA.112.104463. PMID: 23479667.

Sorajja P, Borlaug BA, Dimas VV, Fang JC, Forfia PR, Givertz MM, Kapur NK, Kern MJ, Naidu SS. SCAI/HFSA clinical expert consensus document on the use of invasive hemodynamics for the diagnosis and management of cardiovascular disease. *Catheter Cardiovasc Interv*. 2017 Jun 1;89(7):E233-E247. doi: 10.1002/ccd.26888. Epub 2017 May 10. PMID: 28489331.

Hsu S, Fang JC, Borlaug BA. Hemodynamics for the Heart Failure Clinician: A State-of-the-Art Review. *J Card Fail*. 2022 Jan;28(1):133-148. doi: 10.1016/j.cardfail.2021.07.012. Epub 2021 Aug 10. PMID: 34389460; PMCID: PMC8748277.

Caravita S, Picariello C, Garascia A, Misuraca L, De Tommasi E, Imbalzano E, Enea I, Roncon L, Vatrano M; a nome dell'Area Malattie del Circolo Polmonare ANMCO. Ipertensione polmonare pre-capillare o post-capillare? Il ruolo dei test provocativi in sala di emodinamica [Pulmonary hypertension: pre- or post-capillary? The role of provocative tests in the cath lab]. *G Ital Cardiol (Rome)*. 2022 Jul;23(7):533-541. Italian. doi: 10.1714/3831.38171. PMID: 35771019.

## **Semester**

4th year, second semester

## **Assessment method**

Autonomous interpretation of a cardiopulmonary exercise test  
Autonomous interpretation of an exercise right heart catheterization

## **Office hours**

tuesday 12-13 AM

## **Sustainable Development Goals**

GOOD HEALTH AND WELL-BEING | QUALITY EDUCATION | GENDER EQUALITY

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