

## ANGIOGENESIS REGULATORY MECHANISMS: ROLE IN THE DEVELOPMENT OF TUMORS

1.- General information					
Code	303014	Plan		ECTS	3
Type	Elective	Course	2025/2026	Periodicity	2 <sup>st</sup> Semester
Language		English			
Department	<a href="#">Cancer Research Center</a>				
Virtual Platform	<a href="https://studium.usal.es/">https://studium.usal.es/</a>				

1.1.- Faculty			
Professor Coordinator	Dra. Alicia Rodríguez Barbero		
Department	Physiology and Pharmacology		
Research area	Physiology		
Center	School of Medicine		
Office	Departmental building. Laboratory 227		
Tutorials	Face-to-face: Monday to Friday from 9 to 13 and from 16 to 19 (previous appointment).		
URL Web	<a href="https://endovas.usal.es/grupo/">https://endovas.usal.es/grupo/</a>		
E-mail	<a href="mailto:barberoa@usal.es">barberoa@usal.es</a>	Phone	+34 677555071

Professor Coordinator	Dr. Miguel Pericacho Bustos		
Department	Physiology and Pharmacology		
Research area	Physiology		
Center	School of Medicine		
Office	Departmental building. Laboratory S19		
Tutorials	Face-to-face: Monday to Friday from 9 to 14 and from 16 to 19 (previous appointment).		
URL Web	<a href="https://endovas.usal.es/grupo/">https://endovas.usal.es/grupo/</a>		
E-mail	<a href="mailto:pericacho@usal.es">pericacho@usal.es</a>	Phone	+34 92329500 EXT:1875

<b>Professor Coordinator</b>	Dr. José Manuel Muñoz Félix		
<b>Research area</b>	Biochemistry and Molecular Biology		
<b>Center</b>	School of Biology		
<b>Office</b>	Departmental Building. Laboratory 128		
<b>URL Web</b>	<a href="https://endovas.usal.es/grupo/">https://endovas.usal.es/grupo/</a>		
<b>Tutorials</b>	Face-to-face: Monday to Friday from 9 to 14 and from 16 to 19 (previous appointment).		
<b>E-mail</b>	<a href="mailto:jmmb@usal.es">jmmb@usal.es</a>	Phone	+34 92329500 Ext: 4768

## 2.- Previous recommendations

Interest in scientific research. Good level of English.

## 3.- Aims of the subject

The aim of the subject is to know the physiological significance of the angiogenesis process and its close relationship with the development of cancer; and to know what are the signals that trigger angiogenesis understanding the cellular and molecular mechanisms that induces angiogenesis, as well as their regulatory mechanisms.

The specific objectives are:

- To understand the importance of angiogenesis in the development of tumors.
- To know the role of the different cell types (endothelial cells, pericytes, vascular smooth muscle cells, lymphocytes, parenchymal cells) involved in the process of formation of different types of vessels (arteries, veins, capillaries, lymphatics).
- To understand the role of different growth factors in the induction and regulation of the process and its stop signals.
- To know the cellular processes involved in angiogenesis (activation, proliferation, invasion, migration, cell adhesion, recognition of other cell types, complex formation and multicellular structures).
- To know the characteristics of tumor angiogenesis and understand the similarities and differences with physiological angiogenesis.
- To know the tumor signals that induce angiogenesis and the regulatory factors that are involved in it.
- To analyze the basic processes on which therapies aimed at modifying tumor vessels are based, as well as those aimed at preventing angiogenesis (antiangiogenic therapies).
- To know other vascularization mechanisms independent of angiogenesis
- To know the limitations of this type of therapy.

In addition, student will become familiar with the main original articles that have contributed to illuminate the current knowledge of angiogenesis.

4.- Skills to be acquired / Learning outcomes
<b>Skills</b>
<b>4.1: Basic skills:</b> CG8 -To know how to interpret the results of this type of studies.
<b>4.2: Specific skills:</b> CE2 To recognize the physiological and pathological situations that induce angiogenesis. To know how to interpret plasma angiogenesis markers. To recognize an angiogenesis process in a histological section CE4 To know how to design a study to know the angiogenic effect of different substances, both endogenous and pharmacological. Know how to carry out angiogenesis studies "in vitro" and "in vivo". CE7 To recognize the phases of angiogenesis and the different cell types involved.
<b>4.3: Transferable skills:</b> To organize and distribute group work effectively. To know how to discriminate, analyze and organize the search for information. Comply with the basic rules of a cell culture laboratory and an animal physiology laboratory.

5.- Contents (Syllabus)
<b>Theoretical classes:</b> <ul style="list-style-type: none"> <li>• Concept of angiogenesis and vasculogenesis. Physiological role of angiogenesis. Cellular types involved in angiogenesis.</li> <li>• Signals that trigger angiogenesis. Hypoxia, endothelial angiogenic factors, parenchymatous angiogenic factors.</li> <li>• Cellular and molecular processes that are launched during angiogenesis as well as their regulatory mechanisms.</li> <li>• Role of the different cell types (endothelial cells, pericytes, vascular smooth muscle cells, lymphocytes, tissue parenchyma cells) involved in the process of formation of different types of vessels (arteries, veins, capillaries, lymphatics).</li> <li>• Growth factors that induce or regulate the angiogenesis process and its stop signals.</li> <li>• Cellular processes involved in angiogenesis: activation, proliferation, invasion, migration, cell adhesion, recognition of other cell types, complex formation and multicellular structures.</li> <li>• Characteristics of tumor angiogenesis. Similarities and differences with physiological angiogenesis. Importance of angiogenesis in the development of tumors.</li> <li>• Non-angiogenic vascularization</li> <li>• Tumor signals that induce tumor angiogenesis and the regulatory factors involved in it.</li> <li>• Theoretical bases of antiangiogenic therapy, limitations and new perspectives</li> </ul>
<b>Practices:</b> Practice 1. Evaluation of "in vitro" angiogenesis. Sprouting in aortic rings. Practice 2. Anatomical and pathological analysis of tumor vascularization

6.- Teaching methodology
-Theoretical classes: 8 classes of 1.5 hours. The content of each one of the topics of the course will be exposed in depth. Previously, the student will have access, through the STUDIUM platform, to the content and presentation of the lessons. For each topic recommended bibliography will be

provided which the student can access through STUDIUM.

-Practical classes: 2 practical sessions. In them, the student will monitor the development angiogenesis in vitro.

-Seminar: Students organized in groups of 3-4 people will address a research project related to the content of the theoretical classes. The articles or lines of work to be treated may be chosen by the students or provided by the teacher. In each session the participation of all students will be promoted, and a dialogue will be established evaluable critic.

-Tutorships: Students can access personal or group tutoring whenever they need it. The preparation of group work requires at least one group tutoring.

#### **6.1.- Estimated learning time**

		Hours tutored by the teacher		Individual work (hours)	TOTAL HOURS
		Attendance required (hours)	Distance learning (hours)		
<b>Lectures</b>		12	3	15	30
<b>Practices</b>	- In classroom				
	- In laboratory			9	
	- In computer classroom				
	- Countryside				
	- Others (specify)				
<b>Seminars</b>					
<b>Work presentations and debates</b>		3	3	9	15
<b>Tutorials</b>		6			6
<b>Online activities</b>			1	2	3
<b>Work preparation</b>		9			9
<b>Other activities</b>					
<b>Exams - evaluation</b>		3			3
<b>TOTAL</b>		<b>33</b>	<b>7</b>	<b>26</b>	<b>75</b>

#### **7.- Materials, other bibliographical, electronic references or any other type of resource**

It will be provided by the teachers during the course of the course.

#### **8.- Assessment**

##### **8.1: Assessment Criteria:**

Evaluation is a key element in the process of teaching and learning, and to evaluate is to track along the process that allows information about how it is carried out, in order to readjust the educational intervention, according with the obtained results

Identification of the elements related to the angiogenic process.

Ability to discuss and integrate the concepts related to the program.

Ability to differentiate physiological and tumor angiogenesis.

##### **8.2: Assessment Systems:**

Evaluation of participation in theoretical and practical sessions. (30% of the final grade)

Evaluation of the presentation and defense of group work (understanding of the work, connection with the theoretical knowledge acquired, discussion, ability to synthesize and present) (40% of the final grade).

Written test: the theoretical knowledge acquired in classes and seminars (30% of the final grade) will be evaluated.

**8.3: General Considerations and Recommendations for Assessment and Resit:**

Understanding of the subject taught in the theoretical and practical classes.

Study of the recommended readings

Review and analysis of the subject taught in the theoretical and practical classes.

Use of tutorships.

**9.- Weekly Teaching Schedule**