Discipline MCP5890
Regenerative Medicine and Tissue Engineering in Thoracic and Cardiovascular Surgery

Concentration area: 5156

Creation: 15/10/2020

Activation: 15/10/2020

Credits: 2

Workload:

Theory (weekly)	Practice (weekly)	Study (weekly)	Duration	Total
10	6	14	1 weeks	30 hours

Professors:

Luiz Felipe Pinho Moreira

Paulo Francisco Guerreiro Cardoso

Objectives:

OBJECTIVE: Address the fundamentals, materials and techniques of experimentation involving tissue engineering and regenerative medicine applied to thoracic and cardiovascular surgery. In this context, to analyze the existing models and proposals, emphasizing their advantages and disadvantages, providing the discussion of the levels of evidence observed and the perspectives of their clinical applications.

Rationale:

RATIONALE: The treatment of end stage heart and lung diseases continues to represent an important challenge. In this regard, the approach of the fundamentals, biomaterials and techniques used in tissue engineering and regenerative medicine allows the deepening and expansion of studies in the field of thoracic and cardiovascular surgery. Additionally, it provides a discussion of the various methodological aspects and questions related to the clinical application of these techniques.

Content:

CONTENT: 1. History and rational application of tissue engineering in thoracic and cardiovascular surgery. 2. Fundamentals a. Cell biology applied to tissue engineering. b. Tissue culture in the laboratory. c. Mesenchymal and primordial stem cells. d. Programmed Cells (IPS) 3. Biomaterials and their applications a. Biological scaffolds / Extracellular matrices 5 1. Decellularization methods 2. Processing of extracellular matrices 3. Methods of analysis of scaffolds 4. Bioreactors for recellularization of airway scaffolds b. Non-biological/synthetic scaffolds 1. Types and applications 2. Biodegradable vs Non-biodegradable 4. Techniques for obtaining, storing, and expanding mesenchymal stem cells. 5. Clinical applications a. Applications of

regenerative medicine in cardiac and vascular repair b. Applications of regenerative medicine in central airway repair

Type of Assessment:

See observation field.

Notes/Remarks:

EVALUATION: Evaluation of the course will be conducted from the seminars and the elaboration of a conclusion report, which should follow aspects of the research methodology discussed. NOTE: Minimum number of students: 4 Maximum number of students: 20

Bibliography:

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Influences Adipose Mesenchymal Stromal Cell Plasticity: Prospects for Tissue Engineering and Fibrosis. Stem Cells Int. 2019 May 5;2019:5387850. doi: 10.1155/2019/5387850. 16. Maghsoudlou P, Burns A, DeCoppi P, Niklason LE. Engineered Tissue-Stent Biocomposites as Tracheal Replacements. Tissue Eng Part A. 2016 Sep;22(17- 18):1086-97. doi: 10.1089/ten.TEA.2016.0132. 17. Mao AS, Mooney DJ. Regenerative medicine: Current therapies and future directions. Proc Natl Acad Sci U S A. 2015 Nov 24;112(47):14452-9. doi: 10.1073/pnas.1508520112. 18. Maughan EF, Hynds RE, Proctor TJ, Janes SM, Elliott M, Birchall MA, Lowdell MW, De Coppi P. Autologous Cell Seeding in Tracheal Tissue Engineering. Curr Stem Cell Rep. 2017;3(4):279-289. doi: 10.1007/s40778-017-0108-2. 19. Mazzola M, Di Pasquale E. Toward Cardiac Regeneration: Combination of Pluripotent Stem Cell-Based Therapies and Bioengineering Strategies. Front Bioeng Biotechnol. 2020 May 27;8:455. doi: 10.3389/fbioe.2020.00455. 20. Messner F, Guo Y, Etra JW, Brandacher G. Emerging technologies in organ preservation, tissue engineering and regenerative medicine: a blessing or curse for transplantation? Transpl Int. 2019 Jul;32(7):673-685. doi: 10.1111/tri.13432. 21. Montero P, Flandes-Iparraguirre M, Musquiz S, Pérez Araluce M, Plano D, Sanmartín C, Orive G, Gavira JJ, Prosper F, Mazo MM. Cells, Materials, and Fabrication 7 Processes for Cardiac Tissue Engineering. Front Bioeng Biotechnol. 2020 Aug 11;8:955. doi: 10.3389/fbioe.2020.00955. 22. Nawroth JC, Barrile R, Conegliano D, van Riet S, Hiemstra PS, Villenave R. Stem cell- based Lung-on-Chips: The best of both worlds? Adv Drug Deliv Rev. 2019 Feb 1;140:12-32. doi: 10.1016/j.addr.2018.07.005. 23. Pagliarosi O, Picchio V, Chimenti I, Messina E, Gaetani R. Building an Artificial Cardiac Microenvironment: A Focus on the Extracellular Matrix. Front Cell Dev Biol. 2020 Sep 4;8:559032. doi: 10.3389/fcell.2020.559032. 24. Pina S, Ribeiro VP, Marques CF, Maia FR, Silva TH, Reis RL, Oliveira JM. Scaffolding Strategies for Tissue Engineering and Regenerative Medicine Applications. Materials (Basel). 2019 Jun 5;12(11):1824. doi: 10.3390/ma12111824. 25. Puluca N, Lee S, Doppler S, Münsterer A, Dreßen M, Krane M, Wu SM. Bioprinting Approaches to Engineering Vascularized 3D Cardiac Tissues. Curr Cardiol Rep. 2019 Jul 27;21(9):90. doi: 10.1007/s11886-019-1179-8. 26. Qasim M, Arunkumar P, Powell HM, Khan M. Current research trends and challenges in tissue engineering for mending broken hearts. Life Sci. 2019 Jul 15;229:233-250. doi: 10.1016/j.lfs.2019.05.012. 27. Rehmani SS, Al-Ayoubi AM, Ayub A, Barsky M, Lewis E, Flores R, Lebovics R, Bhora FY. Three-Dimensional-Printed Bioengineered Tracheal Grafts: Preclinical Results and Potential for Human Use. Ann Thorac Surg. 2017 Sep;104(3):998-1004. doi: 10.1016/j.athoracsur.2017.03.051. 28. Sid-Otmane C, Perrault LP, Ly HQ. Mesenchymal stem cell mediates cardiac repair through autocrine, paracrine and endocrine axes. J Transl Med. 2020 Sep 1;18(1):336. doi: 10.1186/s12967-020-02504-8. 29. Spannbauer A, Mester-Tonczar J, Traxler D, Kastner N, Zlabinger K, Hašimbegović E, Riesenhuber M, Pavo N, Goliasch G, Gyöngyösi M. Large Animal Models of Cell-Free Cardiac Regeneration. Biomolecules. 2020 Sep 29;10(10):E1392. doi: 10.3390/biom10101392. 30. Stabler CT, Caires LC Jr, Mondrinos MJ, Marcinkiewicz C, Lazarovici P, Wolfson MR, Lelkes PI. Enhanced Re-Endothelialization of Decellularized Rat Lungs. Tissue Eng Part C Methods. 2016 May;22(5):439-50. doi: 10.1089/ten.TEC.2016.0012. 31. Udelsman B, Mathisen DJ, Ott HC. A reassessment of tracheal substitutes-a systematic review. Ann Cardiothorac Surg. 2018 Mar;7(2):175-182. doi: 10.21037/acs.2018.01.17. 32. van Dongen JA, Getova V, Brouwer LA, Liguori GR, Sharma PK, Stevens HP, van der Lei B, Harmsen MC. Adipose tissue-derived extracellular matrix hydrogels as a release platform for secreted paracrine factors. J Tissue Eng Regen Med. 2019 Jun;13(6):973- 985. doi: 10.1002/term.2843. 33. Varma R, Soleas JP, Waddell TK, Karoubi G, McGuigan AP. Current strategies and opportunities to manufacture cells for modeling human lungs. Adv Drug Deliv Rev. 2020 Aug 22:S0169-409X(20)30116-2. doi: 10.1016/j.addr.2020.08.005. 8 34. White SJ, Chong JJH. Mesenchymal Stem Cells in Cardiac Repair: effects on Myocytes, Vasculature, and Fibroblasts. Clin Ther. 2020 Sep 13:S0149- 2918(20)30389-1. doi:

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Class type:

Presencial