

1. Personal details

Name	TOZZI	First name	PIERGIORGIO
Sex	MALE	Date of birth	JULY 12 1965
Nationality	ITALIAN - SWISS	If Swiss, Canton of origin:	VAUD
Prof. address (with tel., @)	Service de Chirurgie Cardiaque, Rue du Bugnon 46, 1011 LS 021.3142308 Piergiorgio.Tozzi@chuv.ch		

2. Current institutional function(s) of the candidate in the Service/Dpt

Function	Date of award	Ev. note
70% Deputy Physician	August 2017	Cardiac Surgery
30% Chief of the CHUV's Platform for Surgical Research and Educational Program in Surgery	August 2017	Plateforme de Recherche et enseignement chirurgical experimental (PERCE) du Département des Services de Chirurgie et Anesthésie

3. Academic title(s)

Doctorate (MD, PhD, MD-PhD)	Title	Year	University
Associate Professor	Surgical treatment of heart failure	2015	FBM UNIL

4. Undergraduate education

Education	Dates	Institution
Graduation in Medicine and Surgery	1989	Catholic University of Rome (Italy)
Educational Commission for Foreign Medical Graduates (USMLE step 1 and 2) in the United States of America Certification n° 0-526-291-1	1995	
Swiss equivalence of the MD title	2003	FMH Berne

5. Post-graduate education and qualification

a. Main courses/employment before obtaining doctorate and/or specialist qualification

Education	Dates	Institution
Management Interdisciplinary course for executives, CHUV Lausanne	2006	CHUV Lausanne

b. Post-doctorate and/or post-speciality courses/employment

Institution	Dates
Certification of the European Board for Vascular Surgery (Nice, France)	2008
ESPERIS - European Society for Organ Transplant: advanced course on organ transplant, Basel (CH) and Bad Ramsach (D)	2003-2004

c. Specialist title(s) (ISFM or equivalent)

Title	Dates	Institution/country
Specialist in Emergency and General Surgery	1996	University of Milan/ Italy
Specialist in Cardiac and Vascular Thoracic Surgery	2003	FMH Berne/Switzerland
Specialist in Vascular Surgery	2008	FMH Berne/Switzerland

6. Previous professional positions

Institution	Position	Dates
Italian Army	Medical Lieutenant	1990-1991
Emergency Surgery, Milan University, IT	Resident	1992-1996
General Surgery Department, S. Carlo Hospital, Milan, Italy	Attending Surgeon	1996-1998
Cardiovascular Surgery Service CHUV	Attending Surgeon	1998- 2003

7. Research

1) **Development**

Describe your research work in this section, covering at most the past ten years. Please show the consistency of your line of research, as well as its innovative conceptual or methodological aspects.

The research activity has been constant and original, affecting different cardiac domains at different levels. The current research activity has 3 main arms:

- a) **Clinical:** clinical trial on "Optimisation of surgical repair for treating mitral regurgitation with adjustable mitral ring" (OPTIMISE II) to assess safety and effectiveness.
- b) **Pre-clinical:** Feasibility study on new device (Mitralbridge) allowing percutaneous treatment of functional mitral regurgitation.
- c) **Experimental on bench:** conception and development of the first valveless total artificial heart not inspired by nature tested in an original test bench reproducing the physiology of diseased circulatory system.

OPTIMISE II. This clinical study represents the achievement of a successful research story started in 2012 with a patent application (EP 10196656) filed by PACCT/CHUV with myself as inventor. The device addresses the clinical problem of recurrent mitral regurgitation (MR) after surgical repair of either functional and degenerative MR. The rate of recurrent MR goes from 10% to 35% at 1 year and up to 50% at 5 years after surgical repair. This deficiency in the durability of correction of MR confers a predisposition to heart failure, atrial fibrillation, and repeat interventions and hospitalizations. The original device developed with the contribution of a French company (Affluent Medical SA) allows the percutaneous and iterative correction of the residual and recurrent MR after surgical repair, using trans-catheter and balloon-angioplasty techniques. This avoids high-risk re-operation of the heart and frequent rehospitalisation for heart failure. The key feature of the device is its capability to improve the coaptation height pushing the posterior leaflet towards the anterior, therefore, reducing the antero-posterior distance of the native mitral annulus. After extensive pre-clinical studies that are the object of 3 scientific publications in international peer-review journals (see key publications list), the First-in-Human has been successfully done in January 2018 at the Vienna University Hospital by Pr M. Andreas (CHUV was excluded due to conflict of interest policy). OPTIMISE II is the pivotal study involving 8 European leading cardiac centers and having CHUV as the main coordinator.

Mitralbridge. This research aims to assess the feasibility and efficacy of an original surgical procedure for the percutaneous treatment of functional mitral regurgitation. The Vaud cantonal authority for animal research granted to myself the authorisation for an animal study on an adult sheep model (auth. N°VD3384). MitralBridge device and procedure will allow physicians to treat mitral regurgitation through a transcatheter procedure commonly used by interventional cardiologists. The key feature of this technique is to reduce the septal-lateral distance of the mitral valve to increase mitral leaflets coaptation. The final objective is to have a percutaneous and valid alternative to open surgical repair of the MV, with a clear advantage for patients and healthcare costs.

Rollingheart. This original research project addresses the shortage of donors for treating end stage heart failure. The number of heart transplant worldwide has reached a plateau at 4.500/year, but the number of receivers exponentially growth. In 2018 in Switzerland, for each heart available for transplant there were 3 eligible candidates for receiving it. Because of organ shortage a considerable number of patients pass away while waiting the organ. There is a clear need for mechanical circulatory support as an alternative to heart transplant and for destination therapy. The Rollingheart has been conceived by me and its covered by a patent application filed by PACCT/CHUV (EP 16164929). It consists of a single spherical chamber divided in four cavities by two rotating disks. First disk is activated by an electromagnetic variable field. The combined rotation of both disks produces changes in the volumes of the four cavities (suction and propulsion), thus creating the pumping effect. The blood enters/exits in the spherical chamber through four openings located on the same plane and symmetric with respect to the fixed rotation axis. The pump has no valves and pumps blood into both systemic and pulmonary circulation. The close collaboration with the Laboratory for Hydraulic Machines of the EPFL allowed the construction of the first and second generation prototypes that were tested in a dedicate bench test reproducing the hemodynamic pathophysiology of the heart failure. It has been the object of international peer-reviewed publications (see key publication list). The next step is to have the 3rd generation device ready for pre-clinical tests on animal model.

Mention external support obtained (source, amount, period covered) covering at most the past ten years. If finance was awarded to a group or consortium, specify your role within the latter and the amount allocated specifically to you. If you have not yet obtained external funding, please indicate what you intend to do to obtain funding in the future.

2015- 2017 BPI France: Post-operative percutaneous adjustment of the mitral leaflet coaptation (total support Euro 1.2mio). Euro 120K went for the pre-clinical study conducted at CHUV animal research laboratory.

2018 – present Swiss Heart Foundation: Original valveless total artificial heart providing pulsatile flow to be an alternative to heart transplant. CHF 60K

2019 Submitted in May to Innoswiss: Rollingheart, original pulsatile valveless total artificial heart. Total request CHF 1mio where CHF 450K for human resources and bench test studies conducted at CHUV animal research laboratory.

Vision of your research for the coming 5-10 years. Which questions will be approached? Why are they interesting and of broad relevance? What are the innovative elements relative to the state of the field and where do you see your competitive advantage?

Beside completing the current research activity, my energies will focus on developing tools to raise the Swiss educational and training standards in cardiac surgery. One the key points of any teaching process is the assessment of the learning process. The Robotic Assessment of Surgical Skills (RASS) could be the key element for objective and systematic evaluation of the skills learned. Surgical skill development represents an essential part of medical training and it is no more acceptable to learning surgery directly on patients. Acquiring high-quality surgical skills is a time-consuming process that demands expert supervision and evaluation throughout all stages of the training procedure. However, the manual assessment of surgical skills poses a significant resource problem to medical schools and teaching hospitals and results in complications in executing and scheduling their day-to-day activities. In addition to the extensive time requirements, manual assessments are often subjective and domain experts do not always agree on the assessment scores. The objective is to develop an automated, portable, and cost-effective assessment system that replicates the traditional OSATS assessment system without any manual intervention. Using video-based processing for evaluation the skill level of each surgeon. The videos are initially pre-processed and converted into a multi-dimensional time series which is then used to extract different types of features which are used for skill classification. RASS will be coupled with courses on life-like simulators (humanoids) to improve either surgical skills and competences in handling operative complications (Simulation based curriculum). In the next future, the Simulation based curriculum will become mandatory to complete the training program and get the degree of Cardiac and Thoracic Vascular Surgeon in Switzerland, but could also be extended to other surgical specialties.

2) Valorisation

Select your 5 most important publications (appendix) and briefly explain what their strength is.

1. Manuscripts entitled "The role of Heart Failure Team in managing Mechanical Circulatory Support in a Swiss low-volume institution" and "HeartMate 3 in Lowest INTERMACS Profile Cohort: The Swiss Experience" have outlined the importance of working as a team to achieve outstanding clinical results. Availability of a trained Heart Team with expertise in long-term MCS treatment facilitate appropriate patient selection and is probably more important than institutional volume in determining outcomes after VAD implantation.

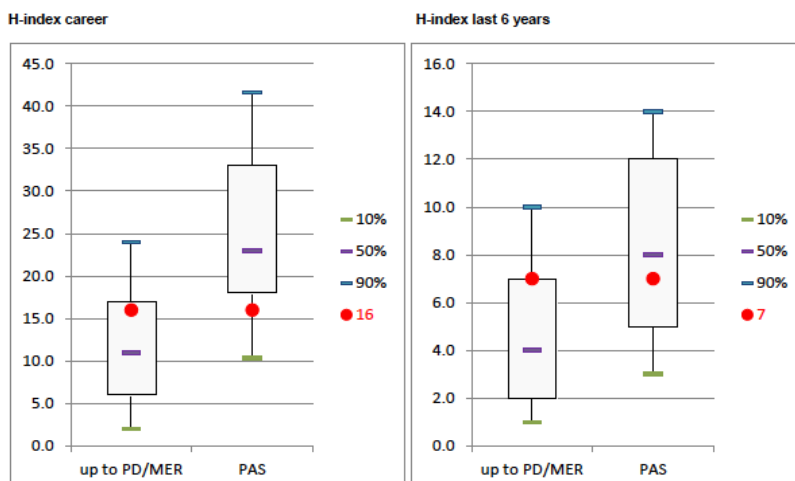
2. Manuscript entitled "An original valveless artificial heart providing pulsatile flow tested in mock circulatory loops" is the first documented feasibility study of a single valveless device acting as total artificial heart having dimensions compatible with pediatric implantation. This could open a new era in the management of end stage heart failure.

3. The manuscripts on adjustable mitral ring are milestone papers because both outlined what I consider will be the optimal treatment of mitral regurgitation (MR). The future of functional MR treatment is towards first surgical restrictive mitral annuloplasty with adjustable ring followed by late, iterative percutaneous adjustments of leaflets coaptation to prevent high risk re-operations and frequent re-hospitalisation for cardiac decompensation (see annex 5).

Bibliometry (number of first and last author papers, list of publications, books).
Patents, softwares, start-ups.

115 scientific publications in peer reviewed journals, 35 as first or last author. Mean journals impact factor is 2.1.

Comparison with clinicians of the Faculty



Patents filed

1. DK1968482 (T3) - ARTIFICIAL CONTRACTILE TISSUE
2. US2014350664 (A1) - Actuating Device for a Surgical implants
3. 7,837,697 Device and method for anastomosis
4. 7,635,375 Device for end-to-side anastomosis
5. 8,439,979 Artificial contractile structure and apparatus comprising such structure
6. 7,208,089 - Biomimetic membranes
7. PT2269540 (E) - ARTIFICIAL CONTRACTILE SPHINCTER
8. US2005020871 (A1) - Artificial contractile tissue
9. CN103547236 (A) - Annuloplasty ring system
10. KR20130089242 (A) - MEDICAL DEVICE COMPRISING AN ARTIFICIAL CONTRACTILE STRUCTURE
11. KR20130089241 (A) - MEDICAL DEVICE COMPRISING AN ARTIFICIAL CONTRACTILE STRUCTURE
12. ES2383960 (T3) - Device for end-to-side anastomosis
13. ES2374073 (T3) - Device and method for anastomosis
14. US5916226 (A) - Apparatus and method for improved sutureless anastomosis
15. US2007078492 (A1) - Method and device to convert cardiac and other body movements into electricity to power any implantable medical system
16. ITMI950097 (A1) - Prosthesis comprising two parts for producing terminal anastomoses in vessels and ducts present in living organisms without sutures and without eversion of the vessel wall
17. 8,480,695 - Device and method for anastomosis

Books

2008 « Sutureless **anastomoses: secrets** for success », 180 pages, Steinkopff Verlag Editor.

Meetings/conferences/scientific events, etc: participation as speaker

152 oral presentations at scientific meetings worldwide.
44 invitations as speakers at scientific meetings worldwide.
4 scientific meetings organised in the last 2 years

3) Supervision

Role in the organization of the research unit. List of past and present PhD students/postdocs. Current position of past researchers. Mentoring activities.

2014 Directeur de thèse du Dr. Stéphanie Perrodin à la Faculté de Biologie et Médecine de Lausanne.
Titre : Système d'assistance biventriculaire pédiatrique à base de muscle artificiel. Current position:
Cheffe de Clinique chirurgie viscérale Berne University Hospital

2019 Directeur de thèse du Dr. Johnatan Emery à la FBM. Title: Rollingheart first valveless total artificial heart.
2016-2019 Leading the multidisciplinary experimental study on the Rollingheart coordinating the activity of the laboratory for Hydraulic Machines of the EPFL, Lausanne Prof. F. Avellan and the Institute for industrial systems of the HES-SO Valais-Wallis, Sion, Prof. S. Chevailler
2018-2019 Principal investigator of the animal research study on percutaneous treatment of functional mitral regurgitation (autorisation Cantonale n°VD3384).

4) Impact

Recognition level (local, national, international). Prizes and awards. Editorial boards. Participation to evaluation panels. Popular scientific publications. Meetings (participation as member of organization).

Prizes and awards:

2010 Nomination CTI Medtech Award for the research « Artificial muscles to control flow in hollow organs », Berne (CH).
2010 Prix Argos Hyppium pour la recherche scientifique sur le système d'anastomose Vasculaire Join. Siponto (IT).
2010 Prix de la Société Européenne d'Urologie pour le meilleur abstract : « New concept of artificial muscle for urinary incontinence ».
2010 Prix de la Société Européenne d'Urologie pour les jeunes chercheurs pour l'application de nouvelle technologie au traitement de l'incontinence urinaire
2004 Prix Sadeghi de l'Université de Lausanne, (CH) pour son activité de chercheuse en chirurgie cardiovasculaire
2003 Prix Lillehei Award Forum de la European Association for Cardiothoracic Surgery pour le travail: "Do valved stents compromise coronary flow?" EACTS / ESTS Meeting - Vienna
1999 Prix de l'European Society for Vascular Surgery pour pour la meilleure étude expérimentale ayant comme titre: "Cross-sectional Compliance is no longer a valid concept: definition of dynamic compliance and its methodology" ESVS XIII Annual Meeting Copenhagen.
1992 Prix de la Société Italienne de Chirurgie Generale pour la meilleure étude scientifique ayant comme titre. "Il chemodectoma carotideo: osservazioni su un caso clinico" 94° Congresso Nazionale, Rome

8. If applicable: Clinical/Support (activités de service)

1) Clinical/Support Practice

Diagnostic and/or therapeutic practice/support, or public health activity. Surgery portfolio or other information.

2006 - 2019 Senior Staff Member at CHUV Cardiac Surgery Service with experience of over 3,000 cardiac procedures in extracorporeal circulation including heart transplant and long term mechanical circulatory support. Handling the program for open and endovascular surgical treatment of thoracic aortic diseases. Full involvement in all clinical activities including rounds, multidisciplinary meetings with colleagues from other specialties than cardiac surgery for modern management of patients and emergency activity (on call).

2015 - 2019 Associate Professor at the Faculty of Biology and Medicine of the University of Lausanne (UNIL); the teaching activity is articulated both at the pre-graduate level and at the post-graduate level. The pre-graduate teaching activity consists of teaching at the bedside and in the operating room to students (cours bloc et stages). The teaching activity at the post-graduate level consists of teaching cardiovascular surgery to surgeons in training, the organization of professional congresses and participation in internal courses at the Department, the Department, the CHUV and the EPFL. and to various cantonal, national and international medical societies.

The teaching and research activity occupies 30% of the time.

2017-2019 Chief of the animal laboratory for surgical research and surgical education (Plateforme d'enseignement et recherché chirurgicale expérimentale - PERCE). This platform has 2 main objectives: giving consistent logistic and technical support for preclinical studies in big animal models either promoted by CHUV/UNIL researchers and promoted by medical industry or external researchers. The other task covers the educational need in the domain of surgery both at pre-graduate (FBM UNIL) and at post graduate level. Annex 3 resumes the educational activity of the platform since October 2018.

Future plans for clinical/support activities

What are your plans for your next 5 years?

My goals are to keep actively contributing to our Institution's image of excellence in care and scientific acquisitions using my spirit of innovation as well as to promote synergies with other functional units, which is key to the success of an institution. Specifically, I will actively participated in the pivotal study on the adjustable mitral ring (Kalios) that I invented and whose intellectual property belongs to the CHUV. Another main goal is to contribute to rising the standards of surgical education in cardiac surgery using specifically developed life-like simulators, called humanoids, with the support of the University of Lausanne and of the Swiss Society for Cardiac and Thoracic Vascular Surgery.

2) Clinical/Support development

Which development have you introduced into your present activity?

The clinical experience on the surgical treatment of end-stage heart failure and the research experience on ventricular assist devices gave me the opportunity to introduce in our Institution the continuous flow left ventricular assist device based on centrifugal pump technology (Heartware) as bridge to transplant in patients on the waiting list for heart transplantation.

Another significant contribution I gave to rising the quality of clinical management of thoracoabdominal aneurysms is illustrated in the publication "how to do it" listed in position 5 of the annex document. Paraplegia has always been the Achilles' heel of Thoraco-abdominal aortic surgery mainly because of the inability to assess the adequacy of spinal cord perfusion and spinal cord function during the surgical procedure. Together with anaesthesiologists and neurophysiologists we defined the clinical procedure to reduce the risk of paraplegia during the surgical treatment of descending thoracic aorta aneurysm.

3) Clinical/Support supervision

What are your involvements in daily clinical supervision, mentoring and promotion of academic/professional careers of junior physicians/scientists?

I'm deeply involved in the post graduate educational program involving trainees in cardiac surgery (annex 4). My commitment goes from the everyday surgical activity where I share with young surgeons my experience in handling the most challenging surgical procedures to the organisation of practical courses such as wet labs with ex-vivo hearts and simulation sessions with humanoids. I also follow the trainees in the final phase of the educational program that consists of performing open heart surgical procedure evaluated by 2 members of the board of the Swiss Society for Cardiac and Thoracic Vascular Surgery.

4) Valorisation and impact

Invitation at meetings/commissions as expert. Clinical meetings (organization and participation).

Creation of new clinical and/or support activities. Involvement in professional and academic societies.

Invited Editorial on the European Heart Journal on the future of functional mitral regurgitation treatment (in press, see annex 5).
Invited speaker at the TechnoCollege EACTS meeting, October 2018, Milano
Member of Organizing Committee of the 8th Biennial meeting of the European Cardiovascular Pathology, Lausanne October 2018
Invited chairman at the Union of Vascular Society of Switzerland, October 2018 Lugano
Invited tutor at the European Vascular Course, April 2019 Maastricht
Invited speaker at the Heart Team Consensus Controversies Compromised in cardiac medicine meeting, April 2019 Vienna
Academic leader (FBM) for ECOS: examens cliniques objectifs structures.
Member of the board of the Swiss Society for Cardiac and Thoracic Vascular Surgery SGHC/SSCC (acting as chief accountant since June 2018).
Founder of the Swiss Academy for Teaching & Training Cardiac Surgery on Simulators with the endorsement of the SGHC/SSCC
Vice president of the Fondation Losannoise des Transplantation d'Organes
Member of the STAH – Swisstransplant as representative of the CHUV/UNIL for heart transplant
Member of l'Union de Sociétés Suisse de Médecine Vasculaire
Member de l'European Association for CardioThoracic Surgery
Member de la Society for Thoracic Surgery
Member de l' American Society for Artificial Internal Organs
Member de la FMH et de la Société Vaudoise de Médecine

9. Teaching

1) Courses

Undergraduate (type, number of hours). Graduate (type, number of hours). Interprofessional teaching. Master's degree works. Exams (writing questions, preparation and participation)

The teaching activity is articulated as well at the pre-graduate level as at the post-graduate level. The pre-graduate teaching activity consists of teaching at the patient's bedside and in the operating room to medical students (cours bloc et stage), to medical students who have chosen the optional course on surgical treatment of heart failure, and to post-doc EPFL students "Wearables and implantables for personalized and preventive healthcare (MICRO-624)". The teaching activity at the post-graduate level consists of teaching cardiovascular surgery to surgeons in training, the organization of professional congresses and participation in internal courses at the Department, the Department, the CHUV and the EPFL. and to various cantonal, national and international medical societies.

Specifically, since 2013 I have been giving to FBM students a "cours option" on the surgical treatment of heart failure, 36 hours and the "répétitoire" in cardiac surgery, 2 hours.

I also prepared the cardiac surgery clinical situation for simulated patient for the ECOS (examens cliniques objectifs structures). In the last 4 years, I acted as tutor for 14 FBM students for their master work.

I also give a 4h hours course to HESAV Physiotherapists for their post graduate educational program.

Future plans for teaching

Should you plan to introduce novel teaching methods, new topics, or propose changes to the curriculum, describe these. Elaborate why they are worthwhile and how they could integrate with the existing teaching activities at the FBM, at other faculties of UNIL, in the CHUV or of the EPFL.

Following the recently introduced PROFILES (Principal Relevant Objectives and Framework for Integrated Learning and Education in Switzerland) I proposed to integrate the teaching activities of the FBM with a practical course on basic surgical procedures, the aim being to give the future MD the principles of hand and wound disinfection and wound care. This activity should be a part of the PERCE teaching activity in collaboration of all surgical specialties represented in our Institution. This activity will contribute to develop the "CHUV label" in terms of standard of care.

2) Development and organization

Organization of teaching programs and modules. Creation of cursus/courses/material. Members of teaching panels. Creation and diffusion of teaching methods.

Cours Option of the FBM on the surgical treatment of heart failure (36 hours).
First cardiac surgery course on life-like simulators. Aortic root and aortic arch surgery, Saarnen August 2018
Swiss Academy for Teaching and Training Cardiac Surgery on Humanoids. CABGs on pump course, Lausanne May 2019

3) Evaluation

Students' evaluations. Prizes and awards. Funds obtained for teaching programs. Master or certified training in education.

Feedback from EPFL students has indicated that my teaching activity is highly appreciated by a scientific and technically competent public, in particular the aspects of innovations and technology transfers. It seems there is scope to adapt the teaching of such complex and advanced information to medical students; therefore, the content and method of the presentation of lessons have to be modified to match their level of interest and knowledge.

Feedback from medical students (annex 2) is positive in terms of clarity of clinical and pathophysiological concepts delivered despite the subject is highly specific. The next step is to downsize technical aspects and emphasise clinical issues helpful for the general practitioner.

Feedback from physiotherapists participating to the post-graduate course has been very positive even if few of them complained on the quality of printed documents provided. Course improved significantly their knowledge with a highly favourable cost/effect ratio.

4) Valorisation and impact

Invitations as expert. Meetings as teacher (organization and participation). Creation of novel didactic concepts. Collaborations between researchers and professionals in education.

My commitment in the educational program of Swiss cardiac surgeons enabled the creation of the Swiss Academy for Teaching and Training Cardiac Surgery. This historic achievement is the result of the close collaboration between the major Swiss cardiac centers. In the 2019 Swiss meeting of cardiology and cardiac surgery societies, I have been appointed to organize a full session on how raising the standards of medical education in Switzerland.

On behalf of the FBM (chargé de mission du Décanat de la FBM) I'm preparing the framework for the collaboration between FBM students

By my signature, I confirm that all the information contained here above and its appendix are certified.

Appendix list:

- Annex 1 Five key publications list
- Annex 2 Students evaluation
- Annex 3 PERCE educational activity
- Annex 4 Flyers of the post-graduate courses in cardiac surgery organised since Aug 2018

Date:

Full name:

Signature of the candidate: