ARUGA Technologies

Nature-inspired vascular reconstruction devices to address unmet clinical needs.

INTRODUCTION

ARUGA Technologies

Aruga is a seed stage medical device startup seeking to re-define the vascular graft market

MARKET

Various forms of artery disease affect over **11 million** Americans today, at a total cost to the healthcare system of **$8.2 billion.**

TEAM

Our team brings passion, a novel convergence of cross-disciplinary expertise, and experience.

SOLUTION

Our patented solution is inspired by biomimicry to solve the biggest challenge in vascular grafts—thrombosis—the same way nature does.

OPPORTUNITY

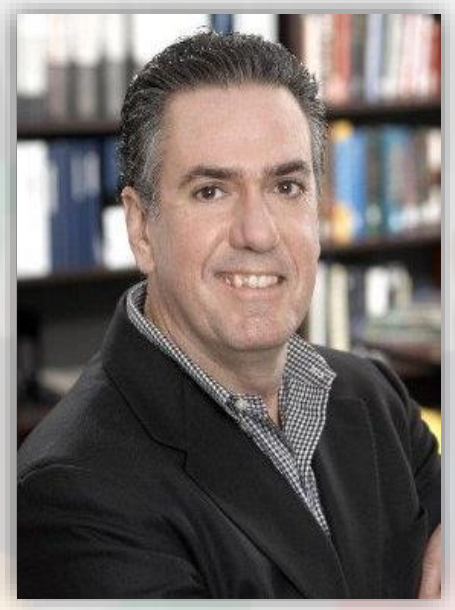
Currently raising a **$1M** seed round to complete pre-clinical testing and chronic animal study.

THE TEAM

ARUGA Technologies

Our team brings a novel convergence of cross-disciplinary expertise

Joseph Pugar
CEO & Co-Founder
Chemical Engineer

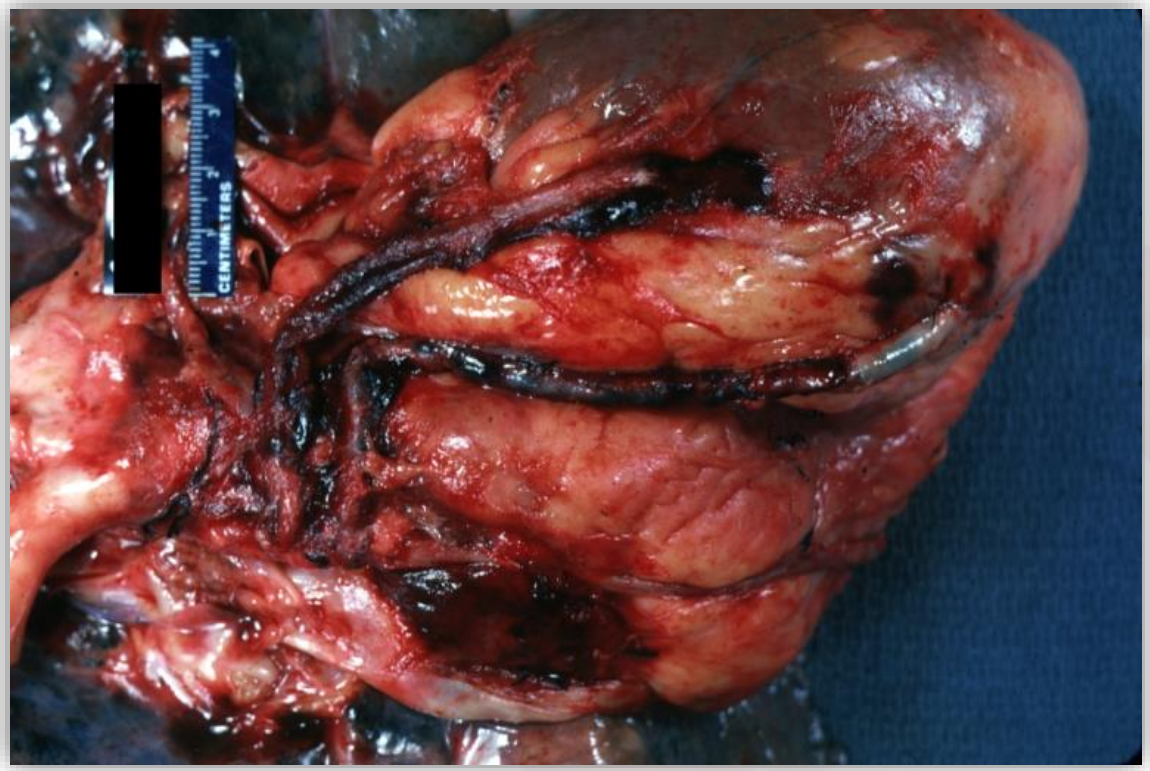


Antonio Torres
Board of Members
Entrepreneur in Residence

Luka Pocivavsek
CTO & Co-Founder
MD, PhD, Surgeon

PROBLEMS

Arteries fail due to diseases like coronary artery disease (CAD), peripheral artery disease (PAD), or require grafting in end stage renal disease (ESRD), which combined, affect over **11 million Americans** each year and **cost over $8 billion to treat.**



PROBLEMS

ARUGA Technologies

When arteries fail, surgeons have limited options, and no good solutions.

	Autograft Harvested from patient	Allograft Donated from cadaver	Artificial Graft Engineered Tissue	Endovascular Stent Engineered Alloy
Coronary Artery Disease	Most often used, but requires multiple surgeries and substantially increased overhead	Some are used today, but reimbursement costs are very high and have limited effectiveness	Fatal degrees of thrombosis occur almost immediately	Dangerous degrees of thrombosis or infection occur within short amounts of time
Peripheral Artery Disease	Patients often do not have viable grafts to harvest; if they do, harvest requires a second surgery	Effectiveness slightly improved, but still very costly compared to synthetic grafts	Dangerous degrees of thrombosis occur within months	Most popular surgical protocol, but infection still probable and procedure has significant hospital overhead
End Stage Renal Disease	Patients often do not have viable grafts to harvest; if they do, harvest requires a second surgery	Very rarely used due to high costs and poor outcomes	Some grafts are used today, but require replacement frequently due to excessive thrombosis	No existing artery is available to stent

SOLUTION

What if there was a solution that had all the convenience of a graft, but antithrombotic properties of the natural vessel?

Innovation landscape is crowded with competitors focused on modifying the chemical properties of grafts

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Aruga uniquely innovates on the mechanical and material properties

SOLUTION

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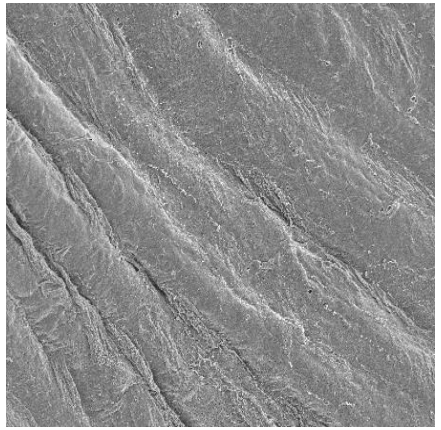
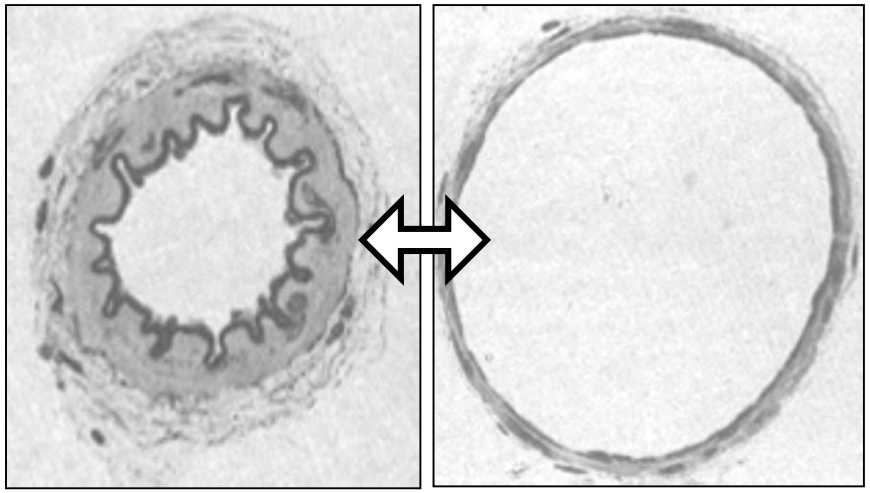
Nature keeps our vessels clear with **dynamic wrinkles**

Nature

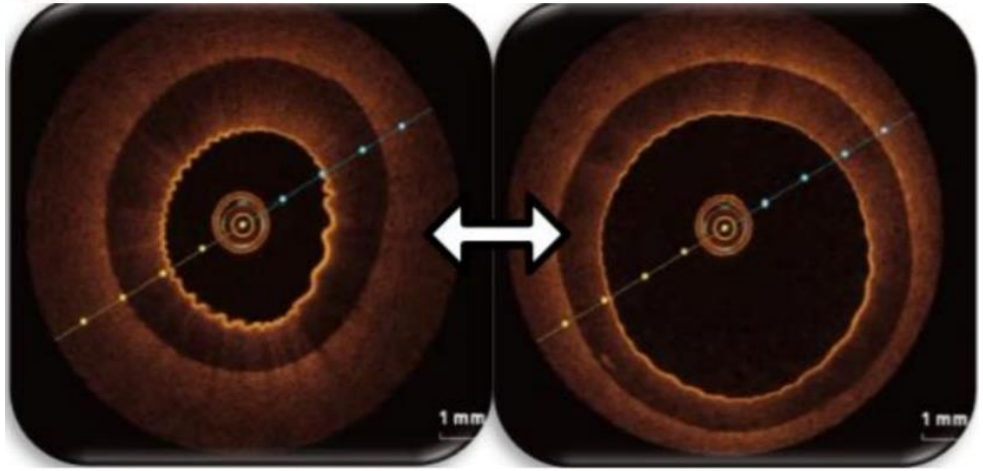
Arterial blood contact surface is wrinkled and flattens with each heart beat – wiping the surface clean each time.





Diastole Systole

TopoGraft: Aruga's wrinkling, nature-inspired alternative



PROTECTED WITH PATENTS

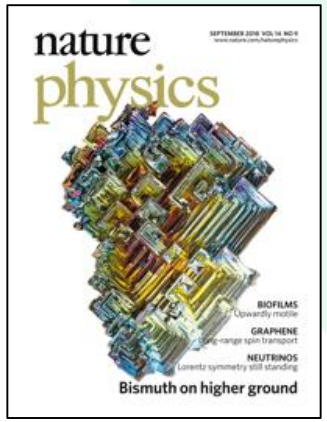
ARUGA Technologies

Our innovation has been protected with patents and validated with prestigious publications

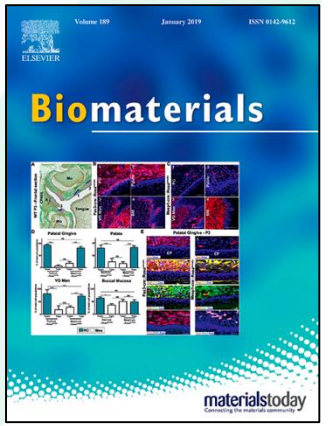
"Tuning Adhesion at Contacting Device Interfaces: Geometric Tools for Minimizing Surface Fouling" No. 62/409,645

- PCT Patent Application that covers our design and self-cleaning function
- Current Exclusive Option/License Agreement with University of Pittsburgh
- Continuation IP already in preparation

Publications:



"Topography-driven surface renewal" [1]



"Active wrinkles to drive self cleaning"[2]

1. Topography-driven surface renewal L Pocivavsek, J Pugar, R O'Dea, SH Ye, W Wagner, E Tzeng, S Velankar, ... Nature Physics 14 (9), 948-953
2. Active wrinkles to drive self-cleaning: A strategy for anti-thrombotic surfaces for vascular grafts L Pocivavsek, SH Ye, J Pugar, E Tzeng, E Cerda… - Biomaterials, 2018

PROOF OF CONCEPT

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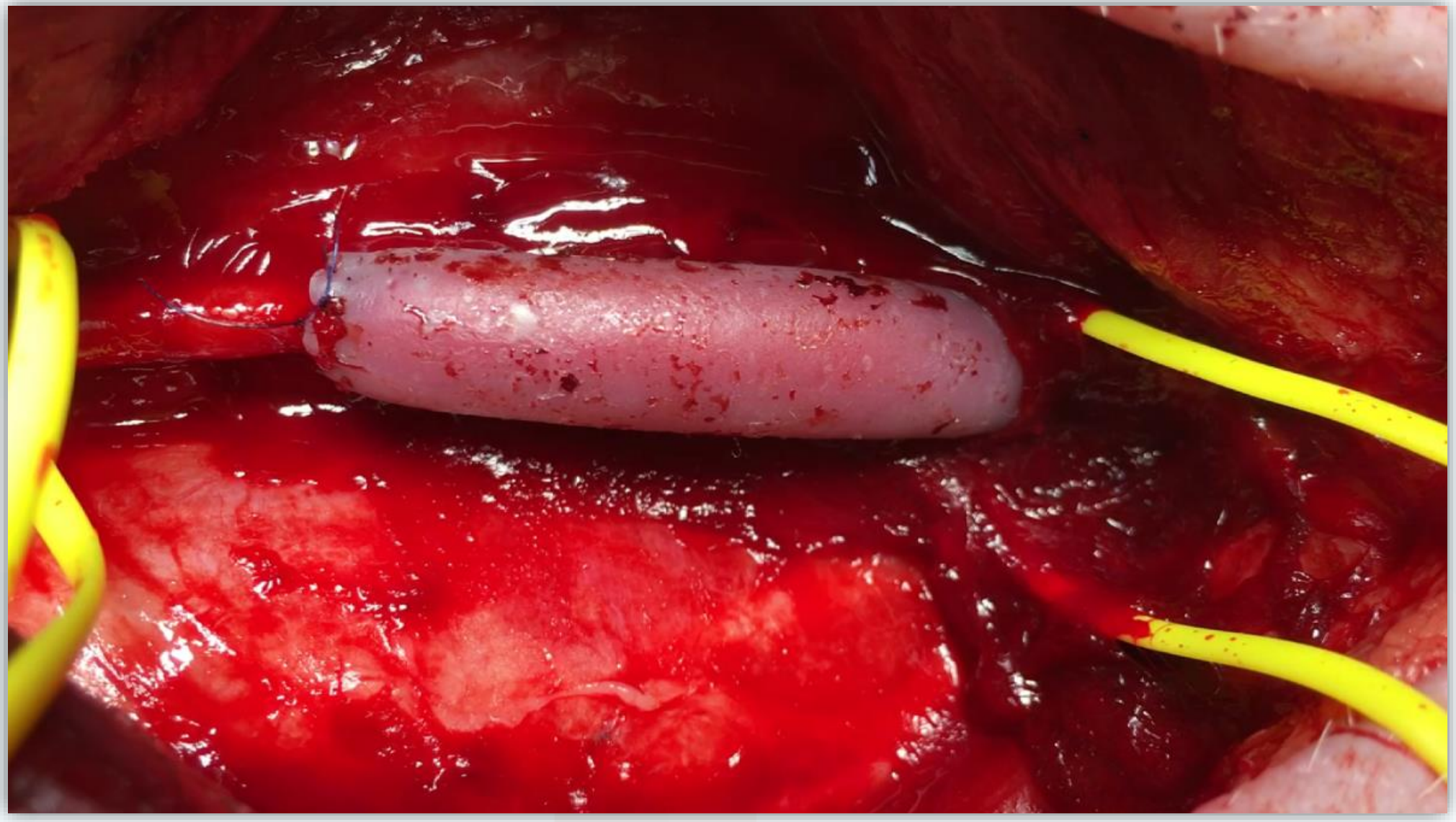
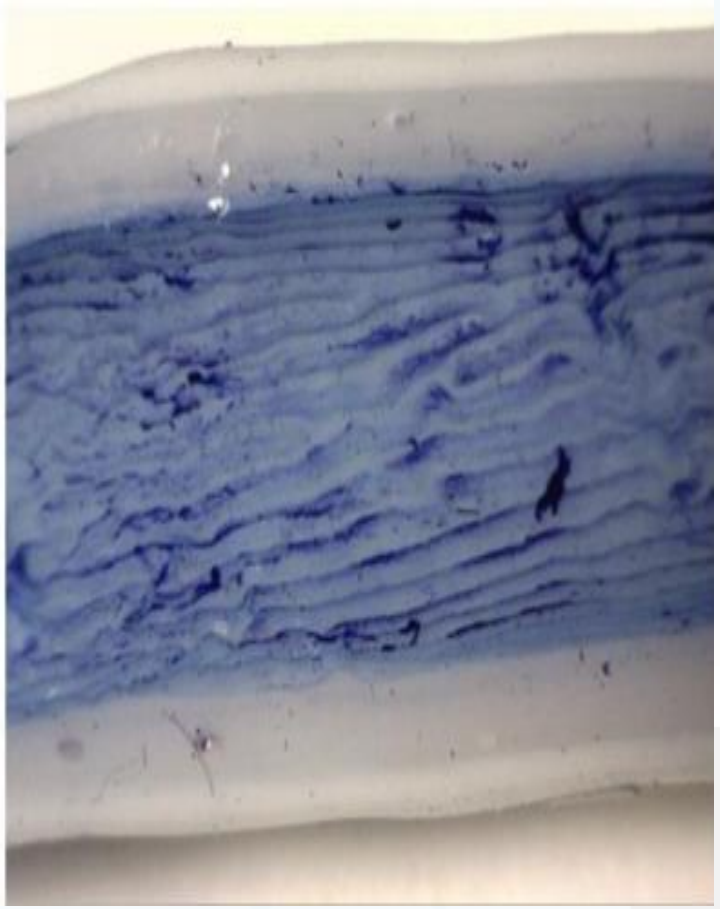
We have completed in-vivo animal and extensive bench testing



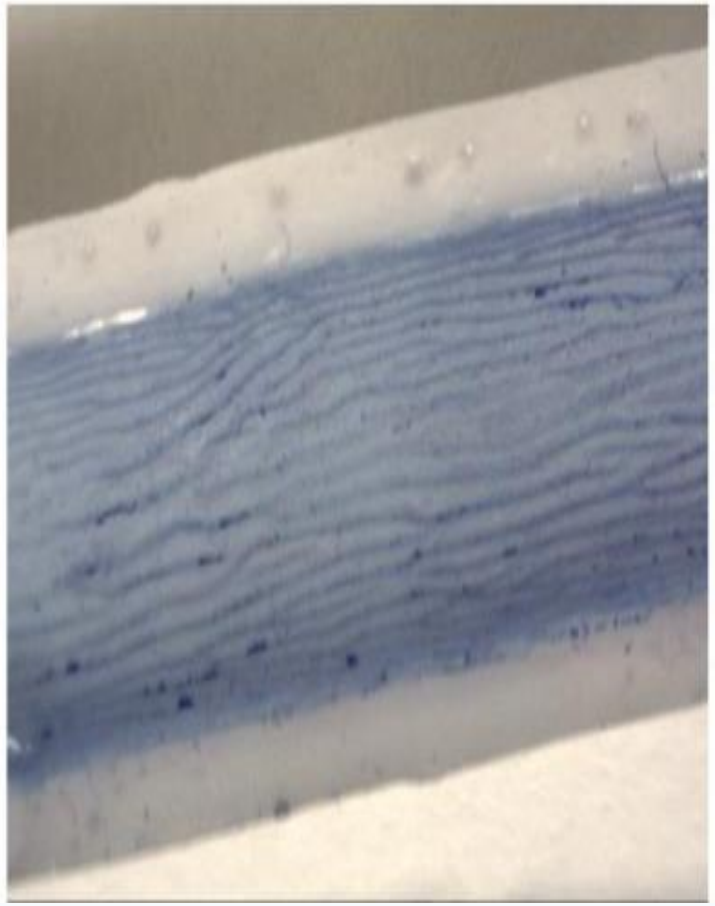
SUCCESS

ARUGA Technologies

IN VIVO EXPERIMENTS demonstrated the dramatic reduction in clotting due to **DYNAMIC TOPOGRAPHY**



Static Topography



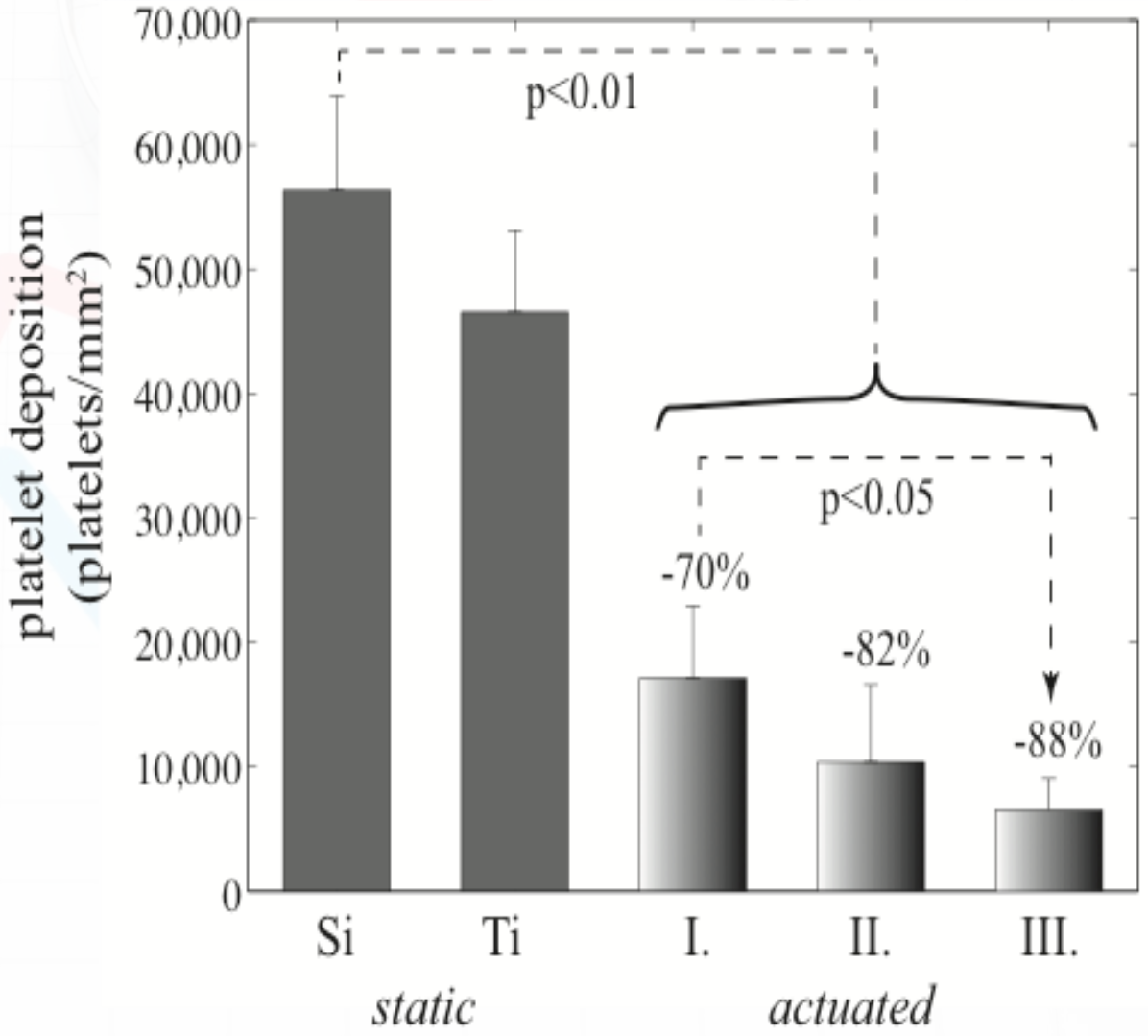
Dynamic Topography

SUCCESS

ARUGA Technologies

IN VITRO DATA shows that expansion and wrinkling combined are most effective

- Expansion/contraction without wrinkling **reduces fouling 70%**
- Wrinkling/flattening reduces fouling **further by 90%**
- Key insight:
  When Wavelength approximates clot size, we achieve optimized self-cleaning



MARKET ACCESS STRATEGY

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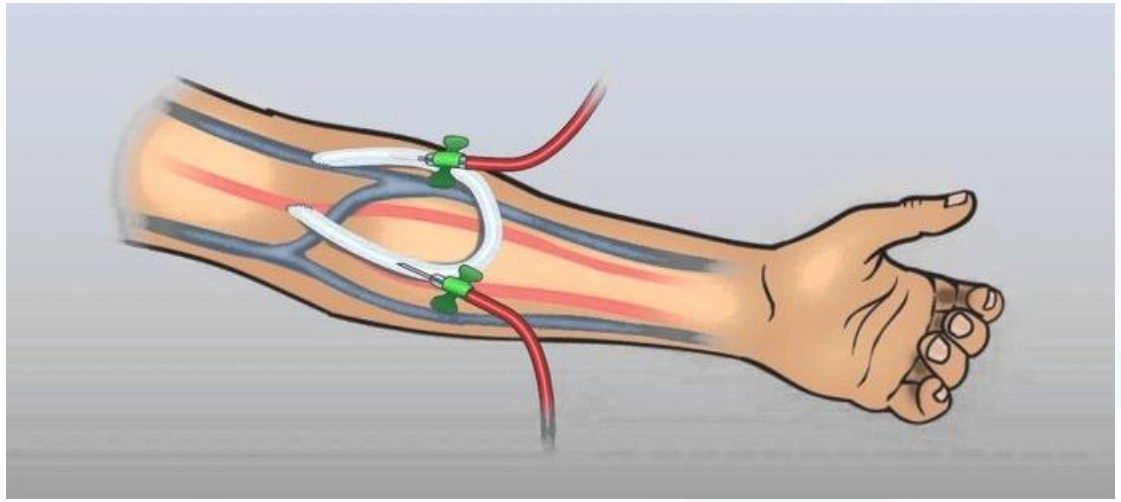
Our market access strategy begins with **AV grafts** as a lower risk entry point

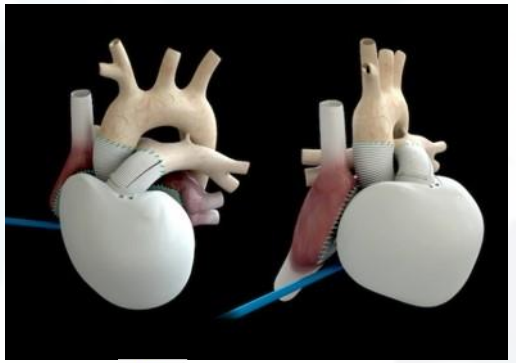
Dialysis Access AV Grafts



- AV graft global reimbursement market to be $270M by 2022
- Additional $2B of incentive value in U.S. alone in rehospitalization costs associated with graft complications (thrombosis, infection, etc.)

Other Markets

- Bypass Grafts ($2B peripheral and $6B coronary potential)
- Artificial Hearts ($2B)



EXPERTS SUPPORT

Edith Tzeng MD

Robert Kormos MD

Larry Klein MD

Fernando Riveron MD

Expert surgeons

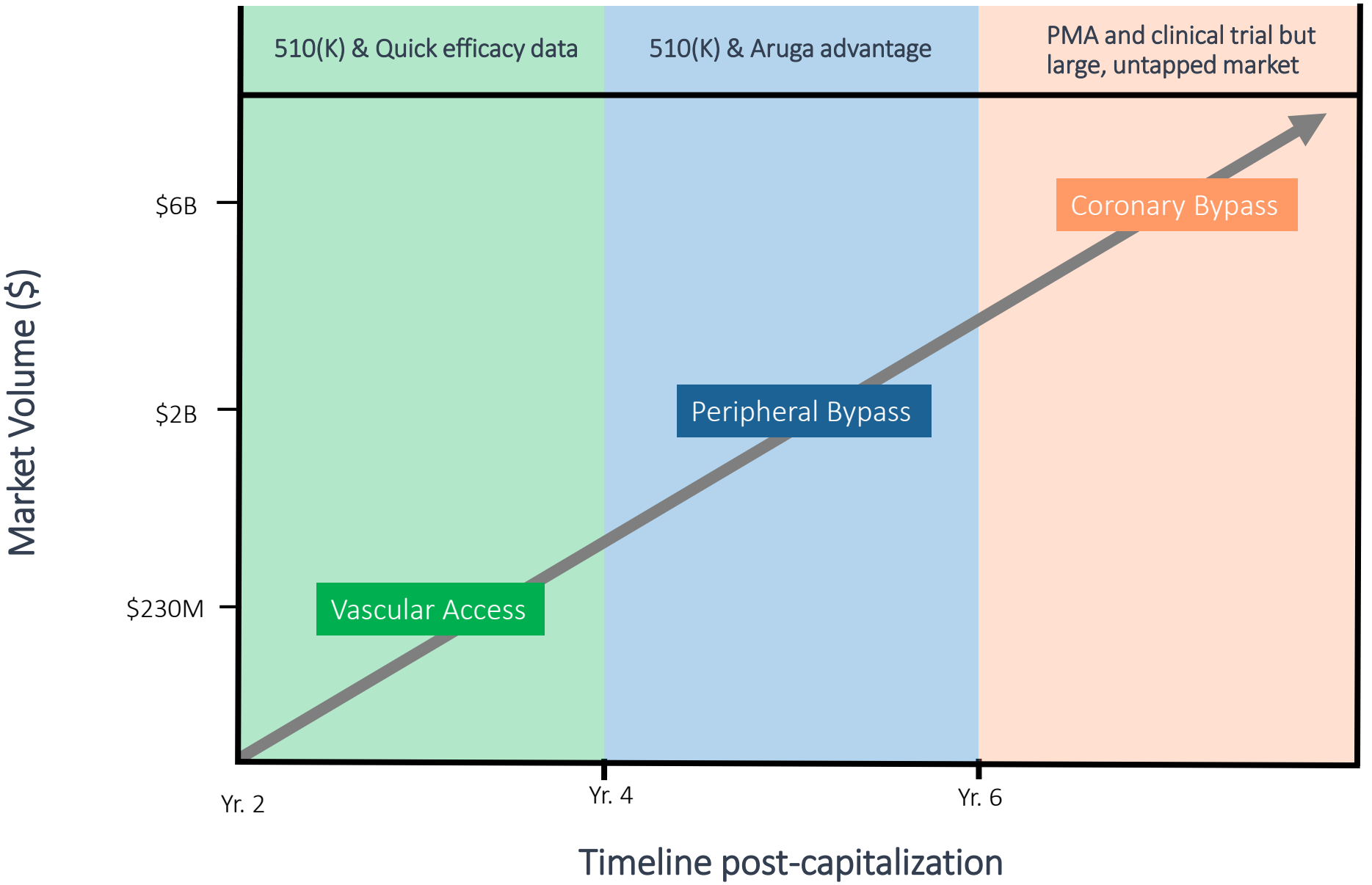
LIKE OUR APPROACH BECAUSE:

- Robust; similar to current surgical devices
- Easy co-implementation within complex cardiac assist device systems

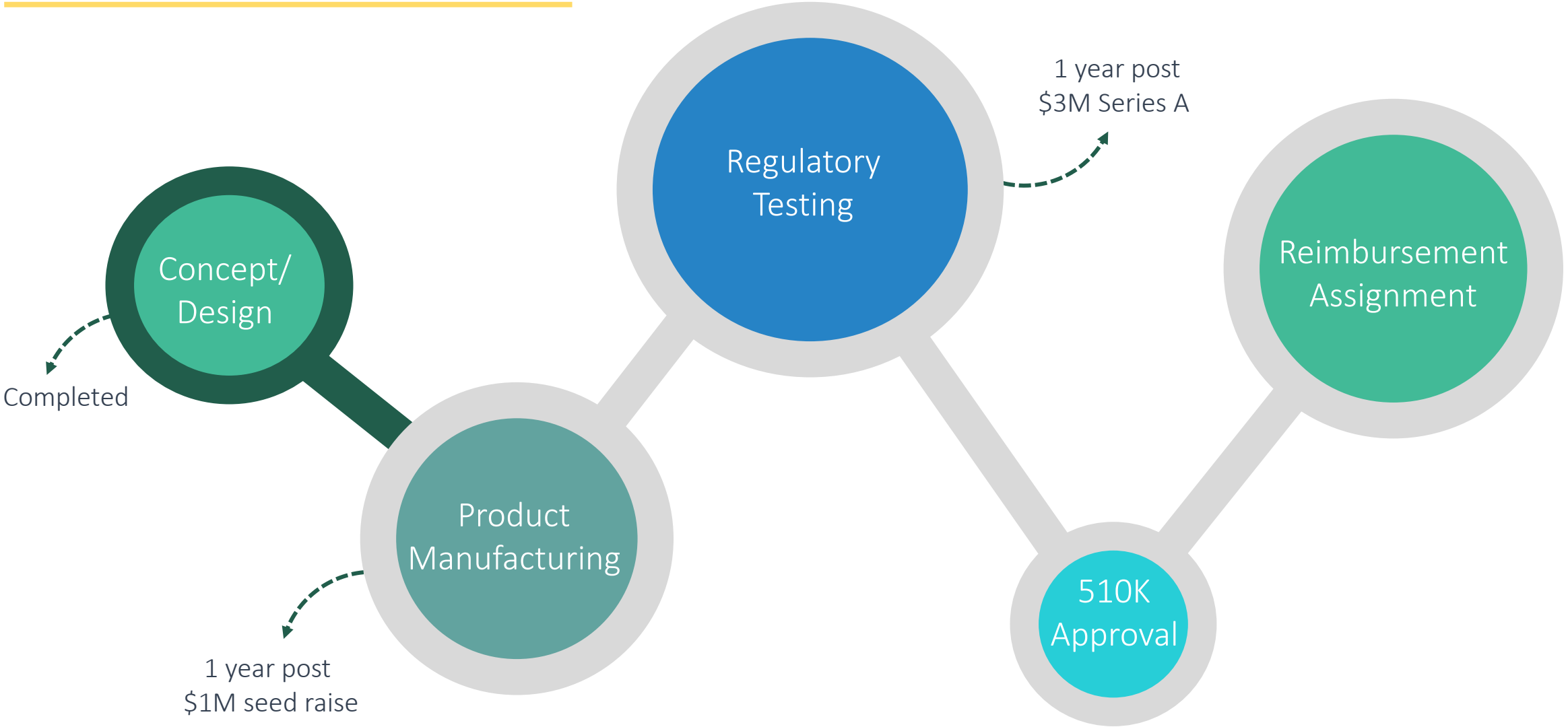
NSF I-CORPS NSF Innovation Corps

- Engineering-based, not theoretical and complex biochemistry

DEVELOPMENT PATHWAY



DEVELOPMENT PATHWAY



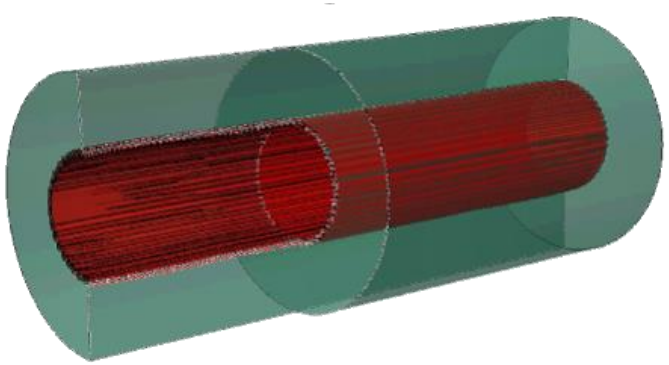
VALUE PROPOSITION

ARUGA Technologies

Our strong value proposition supports **premium pricing**

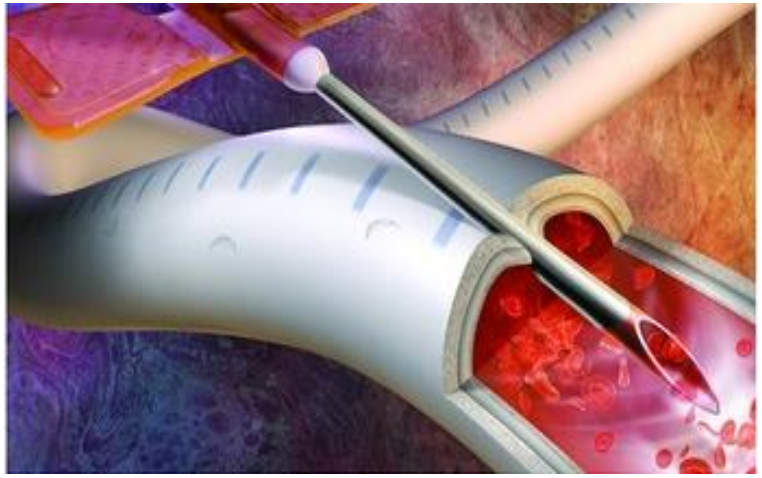
AV graft market is dominated by stiff plastics – specifically Gore's ACUSEAL which is a silicone/Teflon composite just as Aruga intends to use.

Price hospital sees: ~$650



Biodegradable grafts are 10+ years away from market, don't guarantee improved outcomes, and promise to have high cost profile.

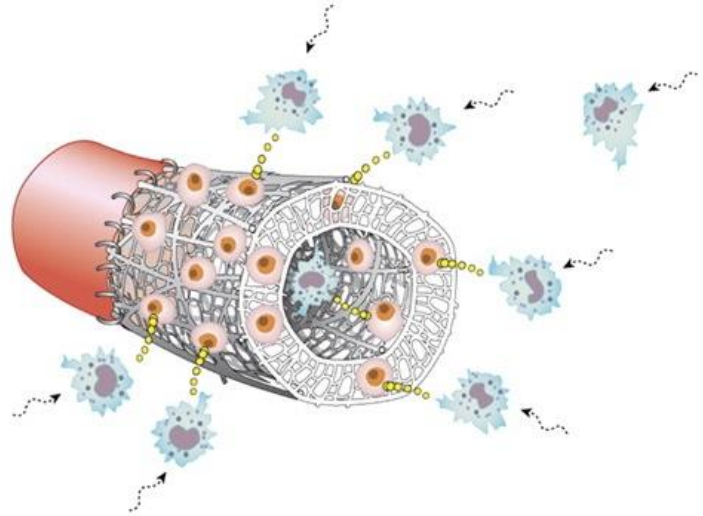
Price hospital sees: ~$10,000 (cyrovein)



We offer:

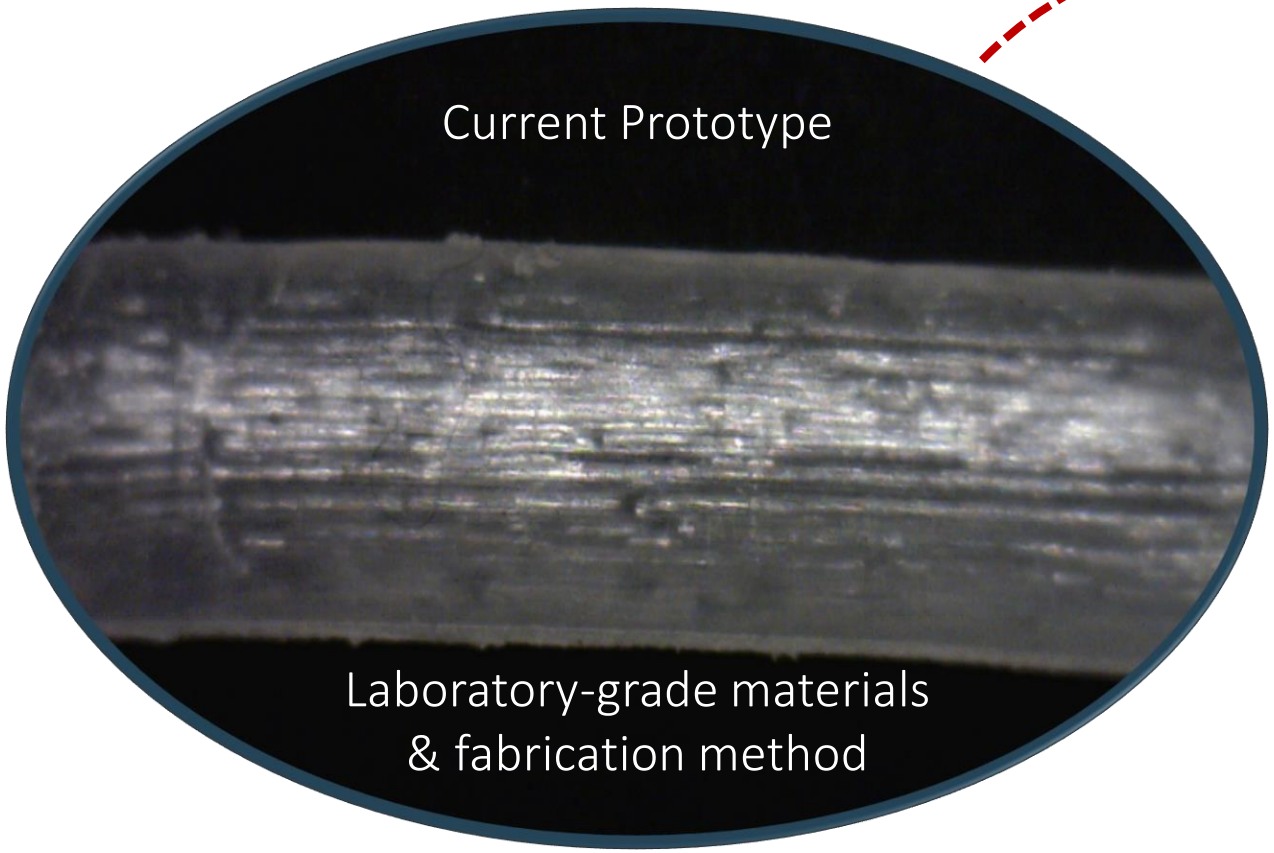
- ✓ Improved long term patency.
- ✓ Reduced intervention and complications.
- ✓ Lower cost position.

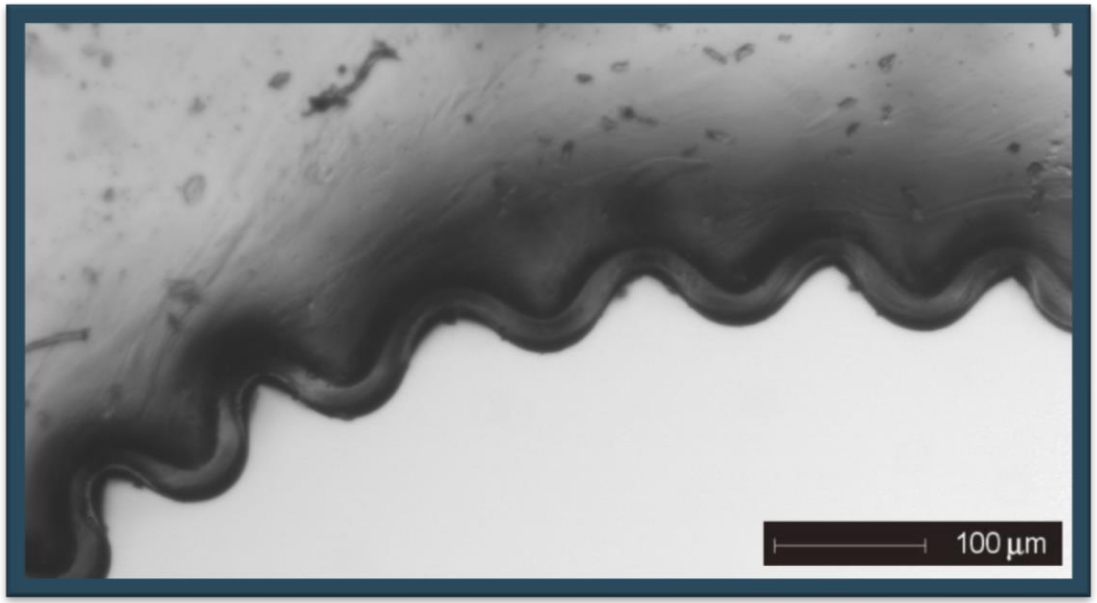
Price hospital would see: ~$900



NEXT STEP: FDA READY PRODUCT

ARUGA Technologies





TRANSITION TO:

Medical Grade PTFE, PET, or PUs

Scalable Manufacturing
(Extrusion/Coextrusion)

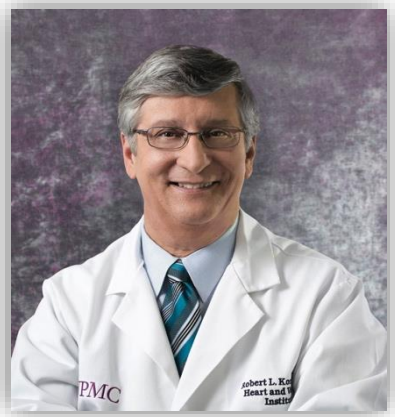
SCIENTIFIC ADVISORY BOARD

ARUGA Technologies

We have built a world-renowned **SCIENTIFIC ADVISORY BOARD**

Edith Tzeng
MD, Chief of Vascular Surgery V.A. Hospital

UPMC University of Pittsburgh Medical Center



Robert Kormos
MD, Multiple Director Positions

UPMC University of Pittsburgh Medical Center

Sachin Velankar
PhD Chemical Engineering Professor

Pitt

Ka Yee Lee
PhD Applied Physics
Vice Provost of Research UofC

THE UNIVERSITY OF CHICAGO 1890

Enrique Cerda
PhD Physical Science Professor

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PARTNERSHIPS

ARUGA Technologies

We have partnered with a **life science incubator** offering a deeply experienced team

Evan Facher
CEO
LifeX Ventures

Mara McFadden
VP of Medical Devices
LifeX Ventures

OFFICE FOR INVESTIGATOR-SPONSORED IND AND IDE SUPPORT (O3IS)

POSSIBLE ACQUIRERS

ARUGA Technologies

LeMaitre® VASCULAR

TERUMO

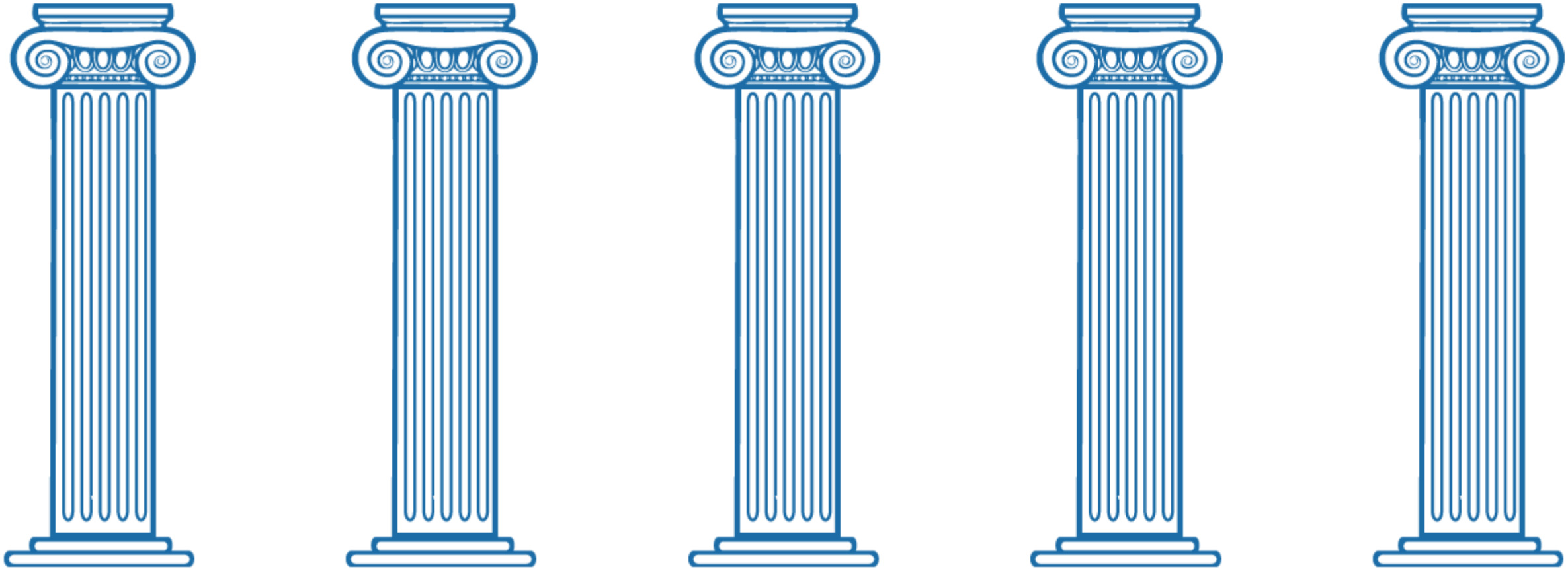
Medtronic

GORE

Creative Technologies Worldwide

FIVE PILLARS OF A SUCESSFUL LIFE SCIENCES STARTUP

ARUGA Technologies



Product Company

Platform Technology

Top Journal Publications

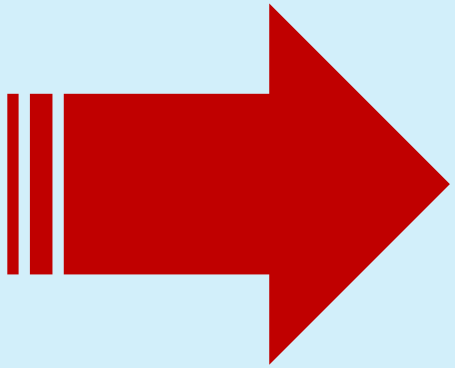
Intellectual Property

***in-vivo* proof of concept**

CONCLUSION

ARUGA Technologies

Merited *TEAM*
Innovative *SCIENCE*
Strong *IP*



Supplying the future's VASCULAR IMPLANTS

Improving PATIENT OUTCOMES

NEXT STEPS

Currently raising a $1M seed round to manufacture market-ready product and begin regulatory testing.

INDUSTRIAL APPLICATIONS

Aquaculture/Algae Products

With large-scale commercial production of algae (for biofuels) on the horizon, incorporation of sustainable technologies in equipment is a clear market segment.

Algae Equipment Market: $227M by 2030

Industrial Process Hosing

The most commercially viable *product* of the industrial applications we've identified. Hydraulic and process fluid lines with increased longevity could be prototyped, tested, and sold to equipment vendors.

$14B spent globally in 2015 industrial fluid line replacement

Roofing/Water Control

With many architecture firms moving to sustainable designs and the greenhouse industry's openness to new technologies, the incorporation of dynamic wrinkles for roof water control and release is an opportunity.

Global Sustainable Roofing Materials Market: $190B by 2026

ARUGA Technologies

Nature-inspired vascular reconstruction devices to address unmet clinical needs.