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Research Report

PDF-fluid-dynamics-16b

Sun, 18 January 2026 20:21

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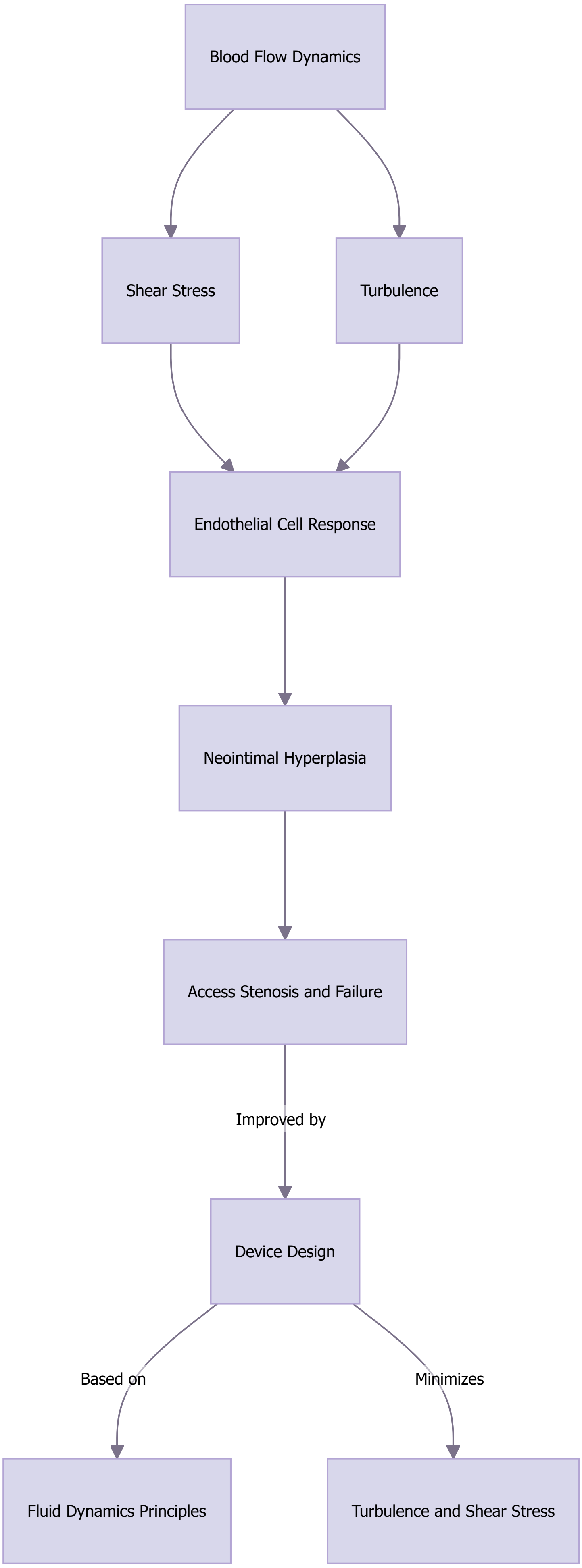
16. Hemodynamics and Fluid Dynamics in Kidney and Cardiac Devices


Blood Flow Dynamics
Shear Stress
Turbulence
Endothelial Cell Response
Neointimal Hyperplasia
Access Stenosis and Failure
Improved by
Device Design
Based on
Minimizes
Fluid Dynamics Principles
Turbulence and Shear Stress

Insights into Hemodynamic Principles and Device Design

Aspect	Details	Key Findings	Supporting Extracts
Fluid Dynamics in Catheters	Blood flow in dual-lumen hemodialysis catheters requires understanding flow rates, shear stress, and blood trauma to prevent hemolysis and clotting [648]	Design must minimize turbulence, whirlpools, eddies, and shear forces to prevent red cell rupture and clot formation.	Mahurkar [648]
Blood Flow Optimization	CFD models analyze blood flow in arteriovenous fistulas (AVFs), considering anastomosis angles, shear stress, and turbulence [610] [676]	Angles <30° favor laminar flow; >46.5° increase turbulence and stenosis risk [610] [683]	Cimino [683] Sellami [669]
Device and Implant Design	Microfluidic and nanostructured filters improve flow and reduce hemolysis in dialysis membranes [648] [664] [664] [624]	Precise pore size, ultrathin membranes, and nanostructures mimic kidney filtration, improving flow rates and reducing injury.	Fissell [648] [664] [624]
Computational Modeling	CFD and multiscale simulations assess turbulence, shear stress, and flow patterns in vascular access and dialysis devices [607] [610] [674]	Accurate modeling helps predict clot formation zones, optimize angles, and improve device longevity.	Bai & Zhu [607] [610] [674]
Hemodialysis and Blood Trauma	Real-time blood damage monitoring via CFD informs device refinements to prevent hemolysis during dialysis [621]	Blood flow simulations predict shear-related red cell rupture, aiding design of gentler flow paths.	Van Buren et al. [621]

Aspect	Details	Key Findings	Supporting Extracts
Artificial Kidney Development	Microfluidic chips and biohybrid systems utilize CFD to optimize flow paths, reducing clotting and improving efficiency [648] [699]	Fluid mechanics ensure proper filtration without damaging blood components.	Fissell [648] [699]
Vascular Access and Remodeling	CFD studies guide optimal AVF configurations, reducing neointimal hyperplasia and stenosis [610] [666]	Angles and flow rates tailored to promote laminar flow and vascular health.	Bai [666]
Turbulence and Shear Stress	Turbulent flow zones linked to restenosis, clotting, and device failure are mapped by CFD [610] [666]	Shear stress modulates endothelial cell behavior, affecting vascular remodeling and device success.	Sellami [669]
Innovations in Device Materials	Nanostructured and bioengineered surfaces designed via CFD modeling decrease thrombogenicity [648] [664]	Stable nanocrystals and functionalized membranes improve flow and biocompatibility.	Brog et al. [648] [664]
Future Directions	Integration of AI, real-time CFD, and advanced nanomaterials aims to enhance device safety and performance [648]	Personalized flow modeling, adaptive device tuning, and improved blood compatibility.	Wadhwa [648]

Key Entities and Concepts

- **CFD (Computational Fluid Dynamics):** The core tool for modeling blood flow, turbulence, shear stress, and device performance in vascular and renal devices [607] [610] [648]

- **Shear Stress:** A pivotal factor influencing endothelial health, hyperplasia, and thrombosis; targeted by design adjustments [666] [683]
- **Vascular Angles:** Critical geometric parameters, with optimal angles <30°, to promote laminar flow and reduce complications [610] [683]
- **Nanostructured Membranes:** Engineered at nanometer scales to mimic physiological filtration, reduce hemolysis, and enhance device integration [648] [664]
- **Device Biocompatibility:** Surface modifications, nanocoatings, and functionalization to minimize clotting and immune responses [648] [664]
- **Fluid Turbulence:** Zones of disturbed flow associated with device failure; mapped via CFD to guide design improvements [610] [666]

Processes and Causes

- **Blood Trauma:** Shear forces during flow induce red cell rupture, hemolysis, and thrombosis [648]
- **Vascular Remodeling:** Hemodynamic forces influence endothelial cell behavior, vessel hyperplasia, and stenosis development [666]
- **Clot Formation:** Elevated shear stress, turbulence, and abnormal flow patterns create nucleation sites for thrombosis [648] [666]
- **Device Failure:** Turbulence and hyperplasia lead to stenosis, thrombosis, and ultimately device malfunction or failure [610] [666]

Impacts and Statistics

Statistic	Implication	Reference
Up to 75% of fistulas need surgery within 1 year [626]	Shear stress and turbulence influence fistula maturation and longevity	626
High shear stress zones correlate with neointimal hyperplasia and stenosis [666]	Design optimization can reduce re-interventions	666

Statistic	Implication	Reference
CFD-guided modifications improve flow, reducing clotting and device failure rates 607 610	Enhances device safety and durability	607, 610

Conclusions

- Precise control of blood flow parameters via CFD is critical for the development of safe, durable vascular and renal devices.
- Optimizing geometric parameters, such as anastomotic angles, and employing nanostructured, biocompatible materials can significantly reduce complications.
- Incorporation of advanced computational models facilitates personalized device design, reduces thrombotic risk, and improves patient outcomes.
- Future innovations will likely involve integrated AI and real-time flow monitoring to dynamically optimize device performance and safety.

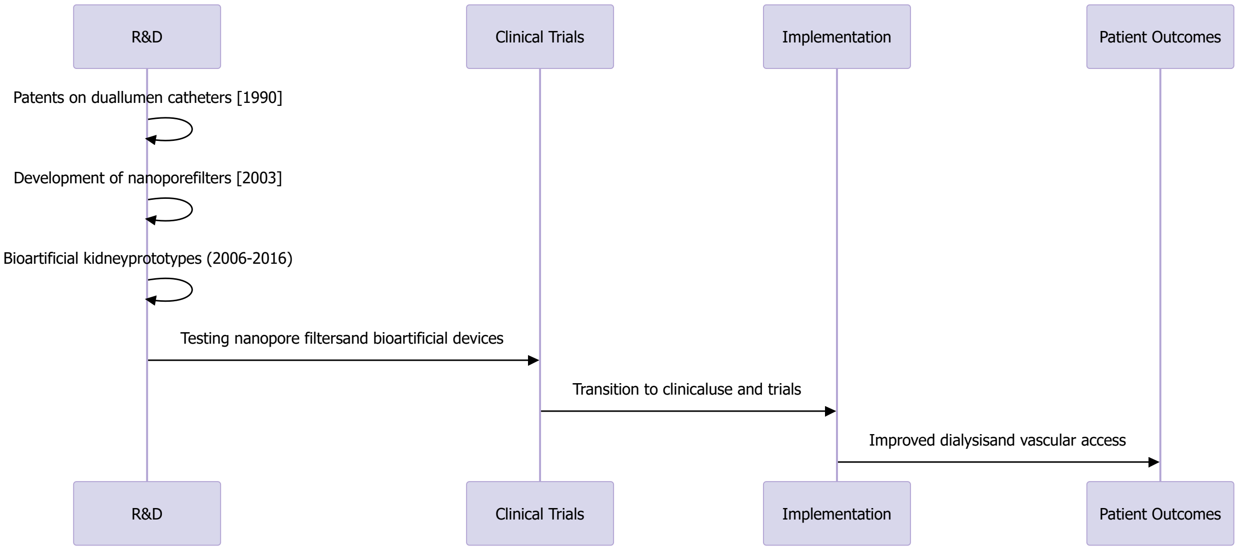
Summary Visualizations of Fluid-Dynamics in Kidney and Vascular Access Technologies

This comprehensive analysis integrates insights from diverse literature on fluid dynamics applications in nephrology, vascular surgery, and medical device engineering. The focus centers on optimizing blood flow, reducing complications like clotting and stenosis, and advancing artificial organ design. The following visualizations elucidate key concepts, relationships, temporal developments, and cause-effect mechanisms relevant to fluid dynamics in kidney disease management.

Preface

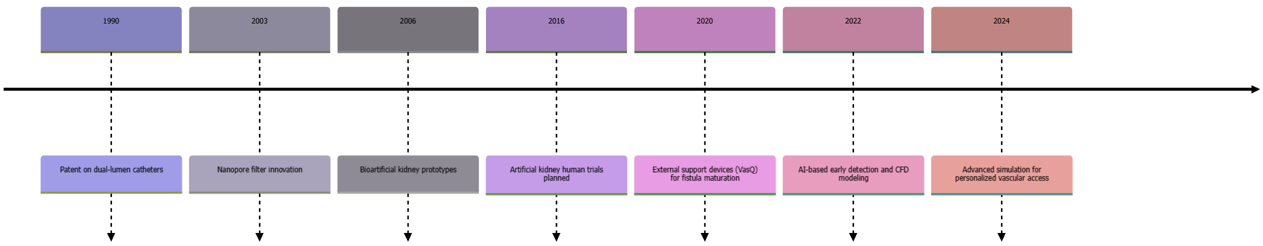
This collection maps the evolution of fluid dynamic principles in medical device design, surgical procedures, and computational modeling to improve vascular access, dialysis efficiency, and artificial organ development.

16.1. Evolution of Artificial Kidney and Vascular Access Technologies



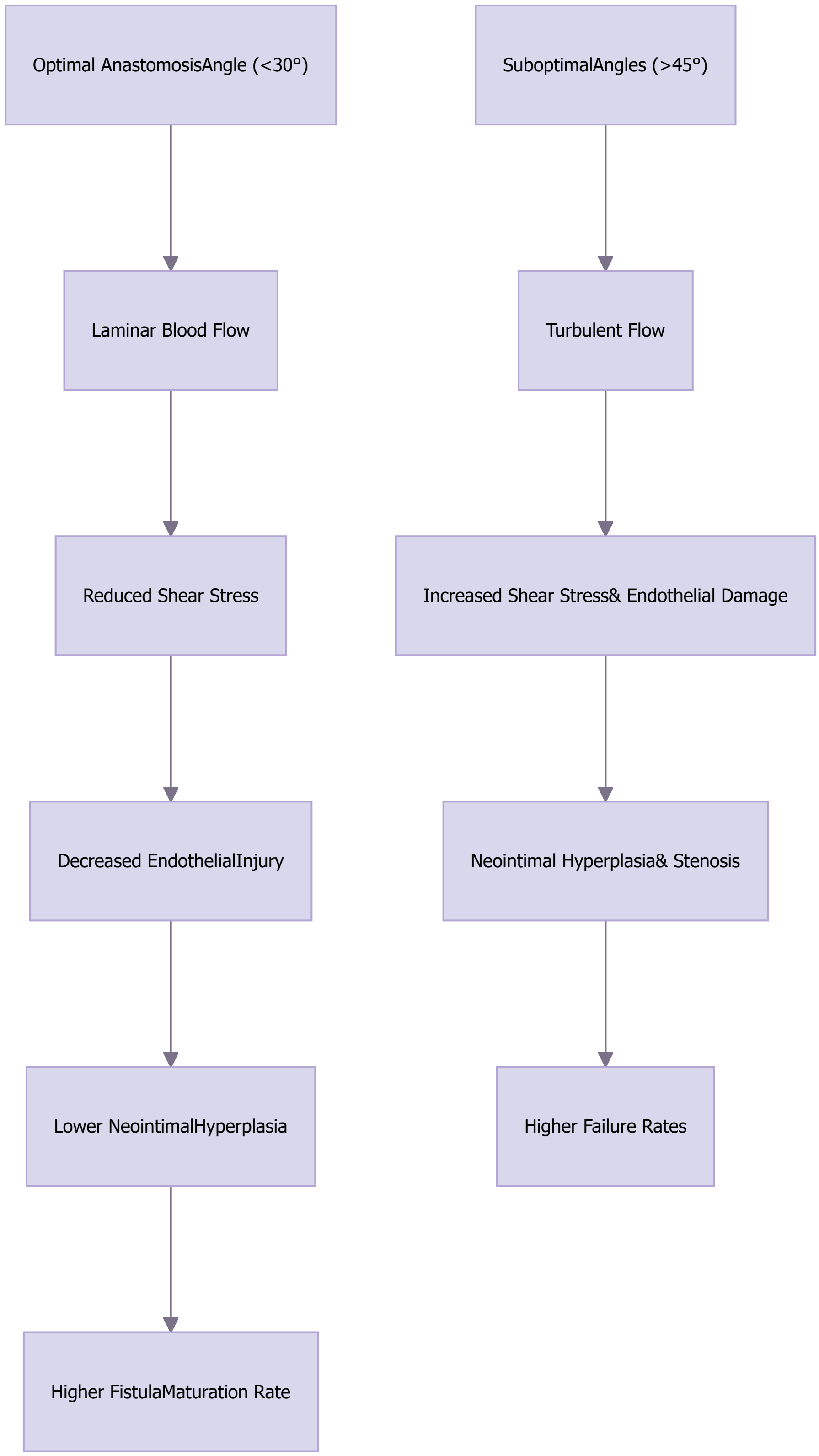
Insight: Progression from catheter design to nanotechnology-enabled filters and biohybrid kidneys reflects increasing sophistication in fluid dynamic optimization, reducing trauma and improving biocompatibility.

16.2. Timeline of Fluid Dynamics Innovations in Dialysis and Vascular Surgery



Insight: Technological milestones span over three decades, highlighting iterative improvements driven by fluid mechanics principles.

16.3. Cause-Effect of Fluid Dynamics in Vascular Access Maturation

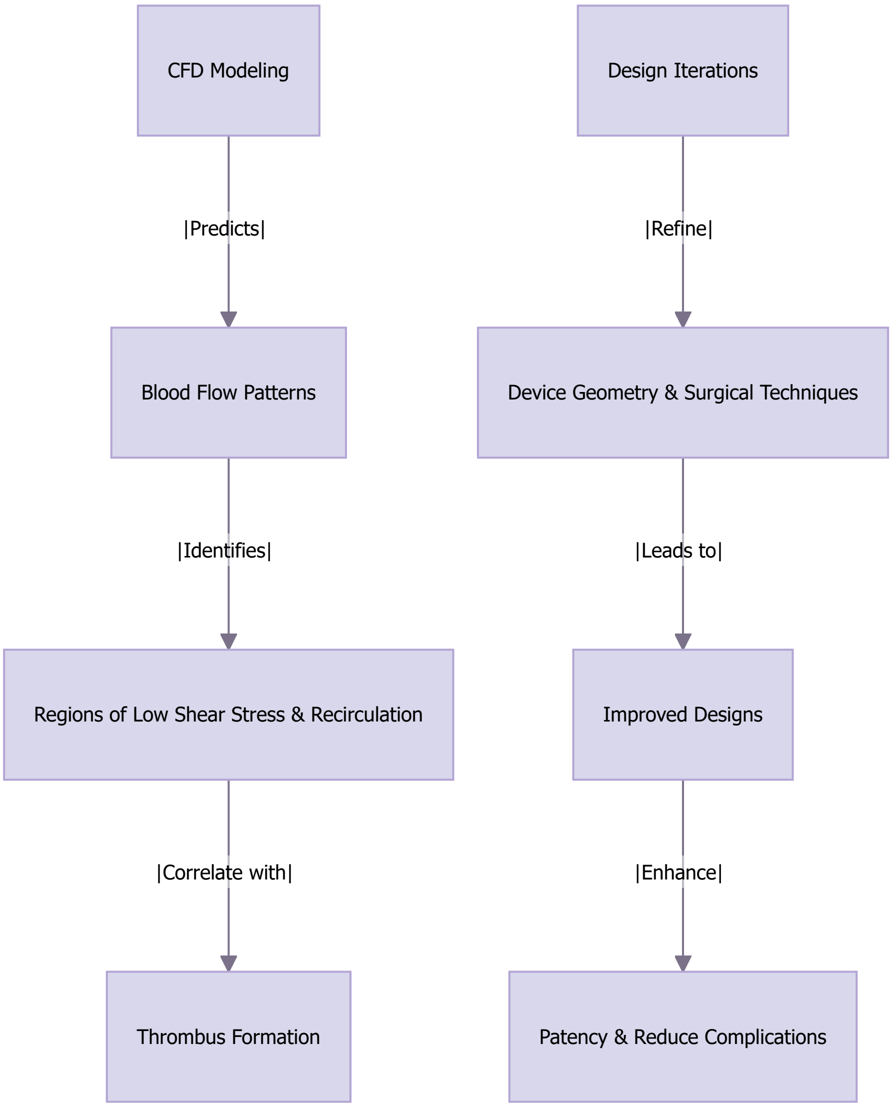


Insight: Precise control of anastomotic angles based on fluid mechanics reduces turbulent flow, thereby preventing hyperplasia and enhancing fistula longevity.

16.4. Relationship between Fluid Dynamics and Clot Formation in Dialysis Devices

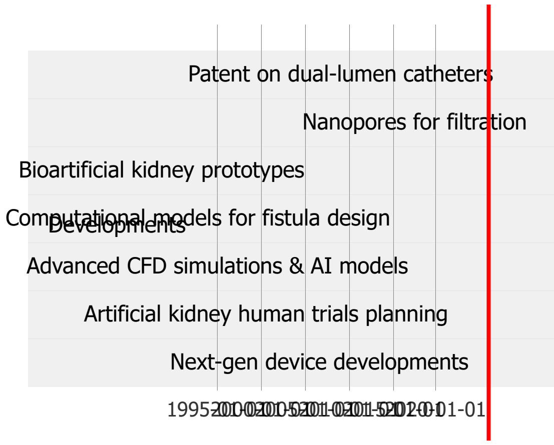
Insight: Managing flow regimes reduces clotting and hemolysis, critical for device durability and patient safety.

16.5. Impact of Computational Fluid Dynamics (CFD) in Device Design and Surgical Planning



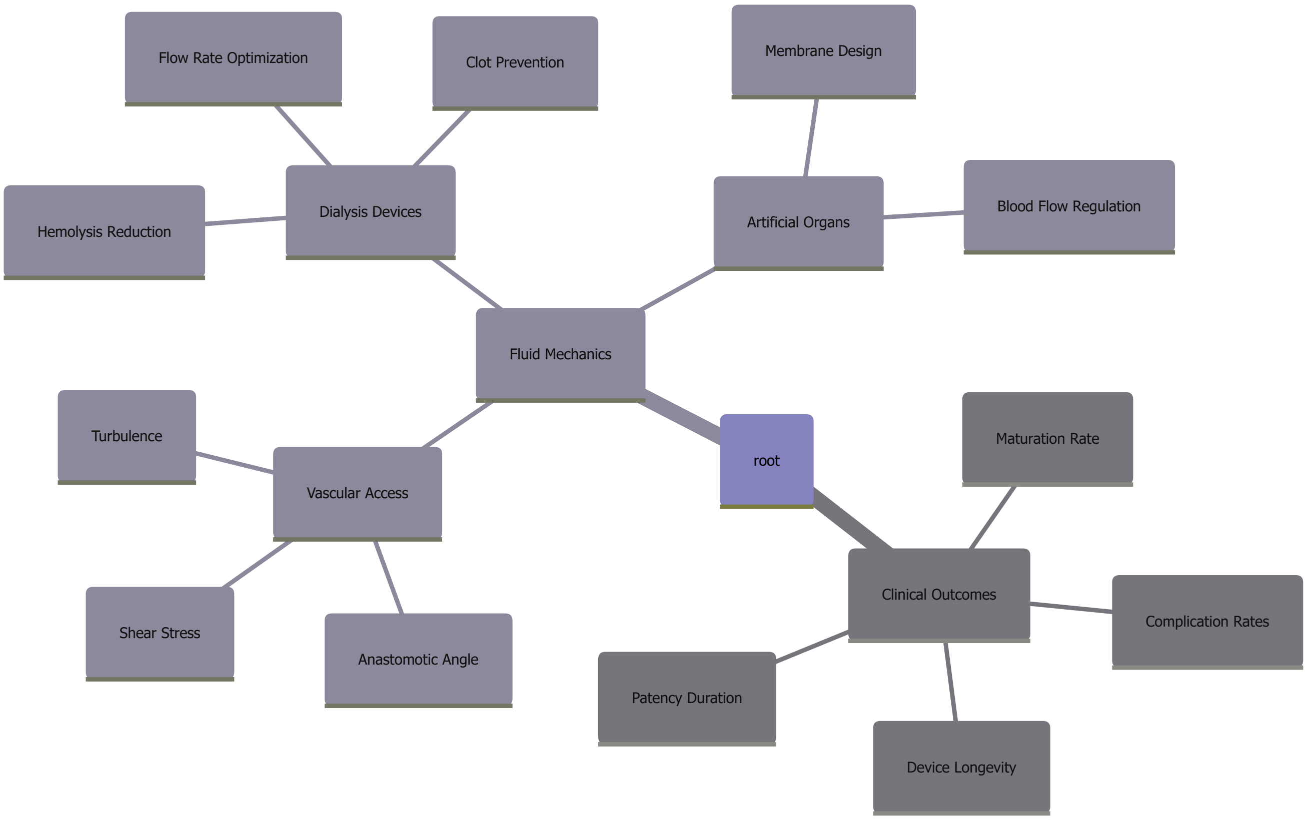
Insight: CFD serves as a cornerstone for rational design, enabling preclinical optimization that translates into clinical success.

16.6. Temporality of Key Fluid Dynamic Concepts



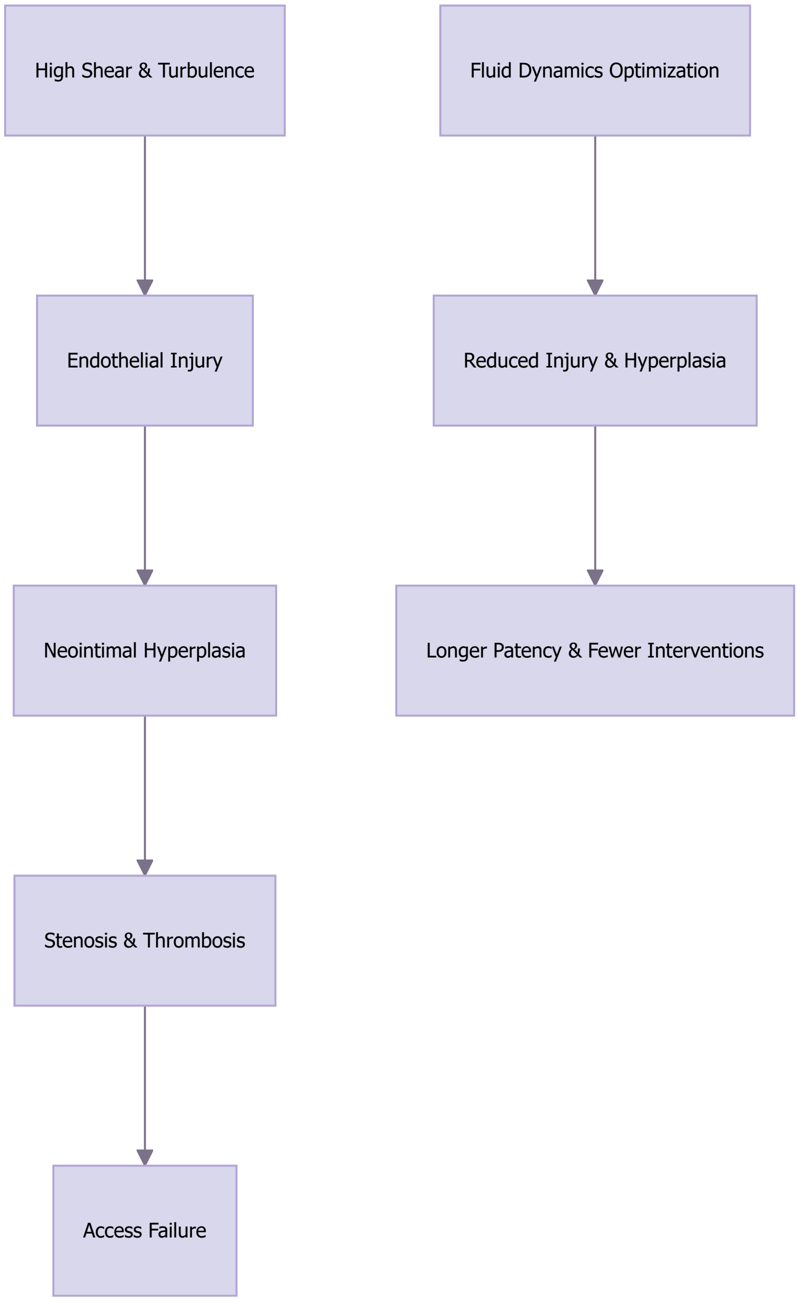
Insight: The chronological sequence underscores the accelerated integration of fluid dynamics with computational and experimental methods over recent decades.

16.7. Interrelationship between Fluid Mechanics and Clinical Outcomes



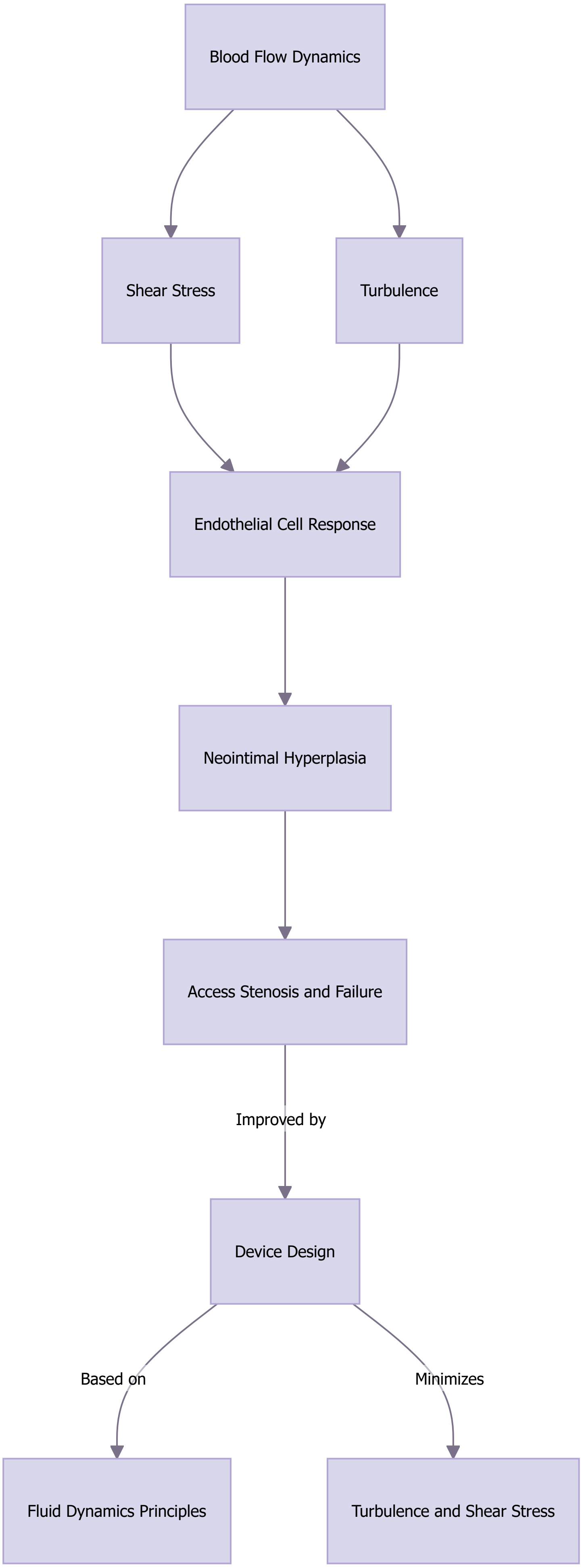
Insight: Understanding fluid mechanics directly informs improvements in device and surgical design, which correlates with enhanced patient outcomes.

16.8. Relationships Between Fluid Dynamics and Disease Pathophysiology



Insight: Controlling flow parameters minimizes pathological vessel remodeling, reducing access failure in dialysis patients.

16.9. Summary of Key Concepts and Relationships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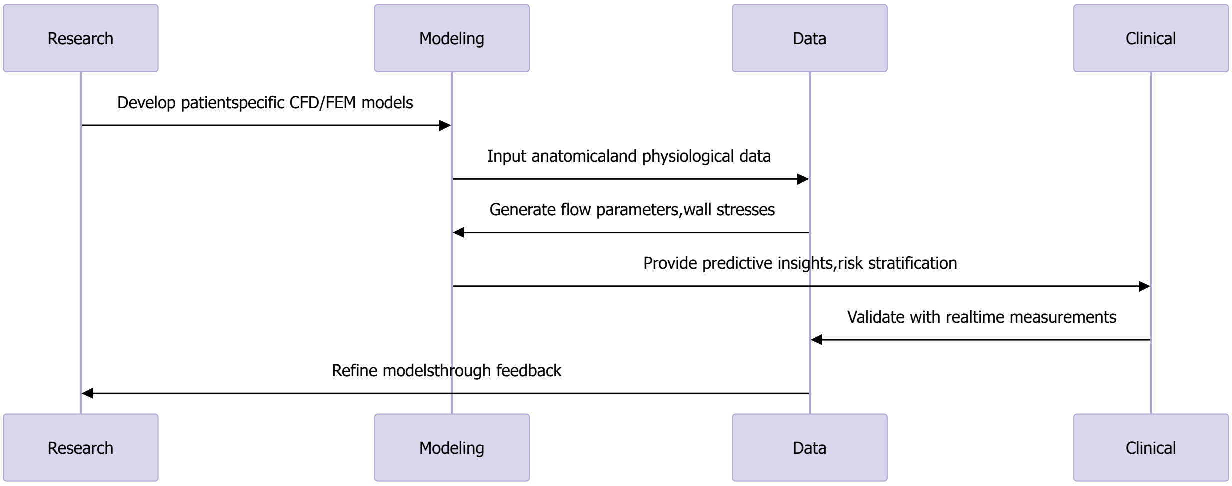
Insight: Application of fluid mechanics principles in device design mitigates pathological responses, prolonging vascular access function.

Final Remarks

Fluid dynamics underpins the development of safer, more durable vascular access and dialysis devices. The continuous integration of computational modeling, experimental validation, and clinical translation accelerates innovations in nephrology and vascular surgery.

End of Visualizations

16.19. Hemodynamic Insights and Computational Models



Hemodynamic Phase Transitions and Early-Warning Indicators

Concept	Explanation	Supporting Extracts
Non-Equilibrium Phase Transition	Sudden shifts in blood flow patterns akin to laser onset or turbulence	947 948
Non-Linear Dynamical Equations	Describe progression of cardiovascular states, pre-transition signals	948
Early-Warning Signals	Indicators such as wall shear stress variations, flow oscillations	948

Insights:

- Hemodynamic states can exhibit critical transitions similar to physical phase changes, where non-linear equations predict imminent events like aneurysm rupture or arrhythmia onset [948]
- Monitoring properties such as wall shear stress (WSS), flow oscillations, and flow pattern alterations provides early warnings for disease progression [948]

Advanced Computational Fluid Dynamics (CFD) Applications

Application	Technique	Impact	Extracts
Hemodynamic Characterization	CFD simulations of arterial stenosis	905 920	
Hemodynamic Risk Assessment	CFD coupled with Windkessel models	907 911 959	
Device Design Optimization	CFD for blood pump impellers, valves	906 922 944	
Aneurysm & Aortopathy Modeling	Patient-specific CFD + FEM	891 945 963	

Insights:

- CFD enables precise modeling of blood flow, shear stress, and pressure distribution, crucial for predicting disease sites and device failure [905] [906] [920]
- Incorporating boundary conditions from wearable sensor data enhances model accuracy and real-time monitoring capacity [887] [939]
- CFD assists in designing devices with minimal shear stress and improved hemocompatibility [906] [944]

Wearable Sensors and Non-Invasive Monitoring

Device Type	Parameters Monitored	Key Features	Supporting Extracts
Bioimpedance Patches	Thoracic fluid, edema	Quantitative, real-time	886 958 964
Photoplethysmography (PPG)	Blood pressure, flow	Continuous, cuffless	895 964

Device Type	Parameters Monitored	Key Features	Supporting Extracts
Ultrasound & Doppler	Cardiac output, flow response	Dynamic, non-invasive	894 909 918
Thermal Sensors	Hemodynamic status	Color-coded heat maps	911

Insights:

- Wearable bioimpedance devices track fluid shifts during dialysis or heart failure, offering continuous insights into hemodynamic status [886, 958]
- Integration with AI enhances interpretation, predicting fluid overload or hypotension [964]
- Ultrasound wearable systems enable dynamic assessment of cardiac and vascular responses to interventions [909]

AI & Machine Learning in Cardiovascular Diagnostics

Application	Role	Extracts
Image Analysis	Automated lesion detection	914 932
Hemodynamic Modeling	Real-time flow prediction	917 939
Risk Stratification	Stroke, rupture prediction	901 944
Device Failure Prediction	Thrombosis, device failure	926 927

Insights:

- AI algorithms interpret complex imaging (CT, MRI, ultrasound) for rapid, accurate diagnosis, surpassing traditional methods [914, 932]
- ML enhances patient-specific modeling, predicting rupture risk or device thrombosis based on flow patterns [926, 944]

- Continuous AI monitoring supports personalized treatment, reducing complications [939]

Patient-Specific Modeling & Digital Twins

Strategy	Function	Example	Supporting Extracts
CFD-Enabled Digital Twins	Simulate individual anatomy & flow	Stroke risk, device planning	949 951
In-Silico Hemodynamics	Assess aneurysm, valve function	Aneurysm rupture, valve calcification	943 964
Longitudinal Mapping	Dynamic, activity-based flow changes	Coronary digital twins	885 887 959

Insights:

- Digital twin models incorporate detailed anatomical and flow data for personalized risk prediction and treatment planning [949, 951]
- They enable simulation of interventions, predicting outcomes like rupture or device failure with high fidelity [943, 964]
- Wearable data feeds into these models for real-time, adaptive patient monitoring [887]

Hemodynamic Parameters & Monitoring Techniques

Parameter	Measurement Method	Clinical Utility	Supporting Extracts
Wall Shear Stress	CFD + Imaging	Aneurysm rupture risk	905 944
Blood Pressure	Cuffless, PPG, ECG	Long-term tracking	894 895

Parameter	Measurement Method	Clinical Utility	Supporting Extracts
Flow Velocity	Ultrasound, PPG	Cardiac output, flow response	909 935
Cardiac Output	Impedance, Seismocardiography	Heart failure management	920 968

Insights:

- Combining non-invasive sensors with computational models refines real-time hemodynamic assessment, aiding early diagnosis [894] [895] [909]
- Dynamic parameters like PPV, SVV, and flow velocities inform fluid management and device adjustments [950]

Clinical & Research Integration

Focus Area	Approach	Implication	Extracts
Disease Prediction	CFD + AI + Wearables	Early intervention, personalized therapy	939 944 948
Device Optimization	CFD + Patient Data	Minimize shear stress, thrombosis	906 922 944
Surgical Planning	Virtual models + Imaging	Improved outcomes, risk mitigation	945 959

Insights:

- Multimodal integration of computational models, AI, and wearable data advances precision medicine in cardiovascular care.
- Continuous monitoring coupled with predictive modeling supports proactive interventions, reducing morbidity and mortality [939]

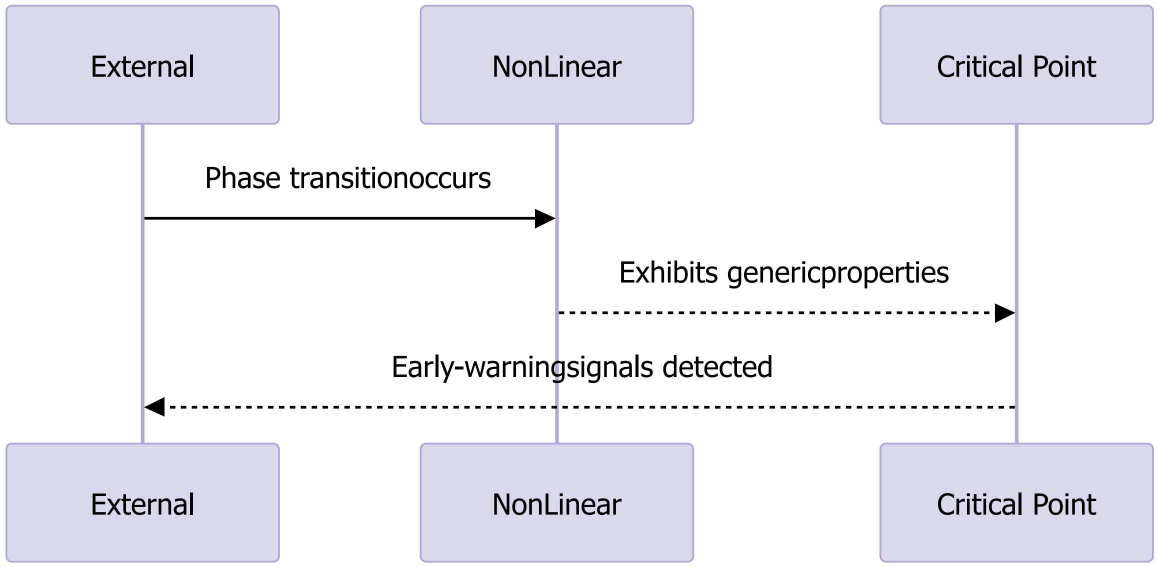
Summary

- **Phase transitions** in blood flow can herald critical events; early warning signals are identified via flow and shear stress analysis [948]
- **Computational tools** like CFD and FEM are central to device design, risk prediction, and understanding disease progression [905] [906] [943]
- **Wearable sensors** and **AI** foster non-invasive, continuous monitoring, enabling dynamic, patient-specific management [886] [939] [964]
- **Digital twins** synthesize anatomical, flow, and device data for real-time, personalized healthcare strategies [949] [951]
- Advancements emphasize **integrative modeling**—merging physics-based simulations with machine learning—to enhance diagnosis, intervention, and device durability in cardiovascular medicine.

Preface for Visualizations

The following diagrams utilize sequence, timeline, flowcharts, pie charts, and mind maps to illustrate the key concepts, relationships, and technological advancements in hemodynamic stability assessment, device development, and computational modeling.

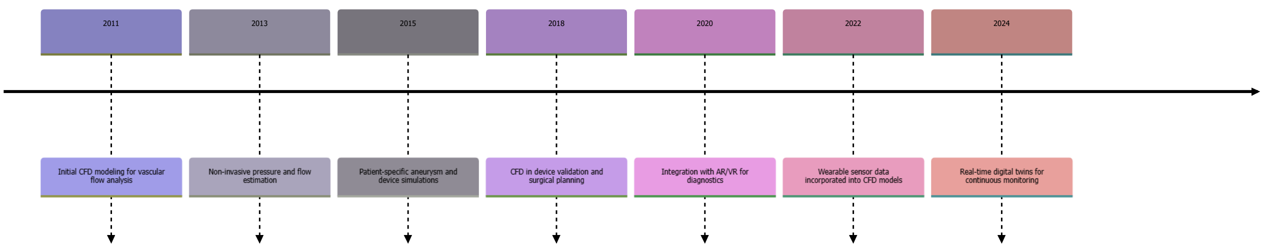
Hemodynamic Phase Transitions and Early Warning Signals



Insight: Hemodynamic shifts can resemble phase transitions; non-linear dynamics and early warning signals enable preemptive clinical interventions.

Temporal development of phase transition understanding informs predictive diagnostics.

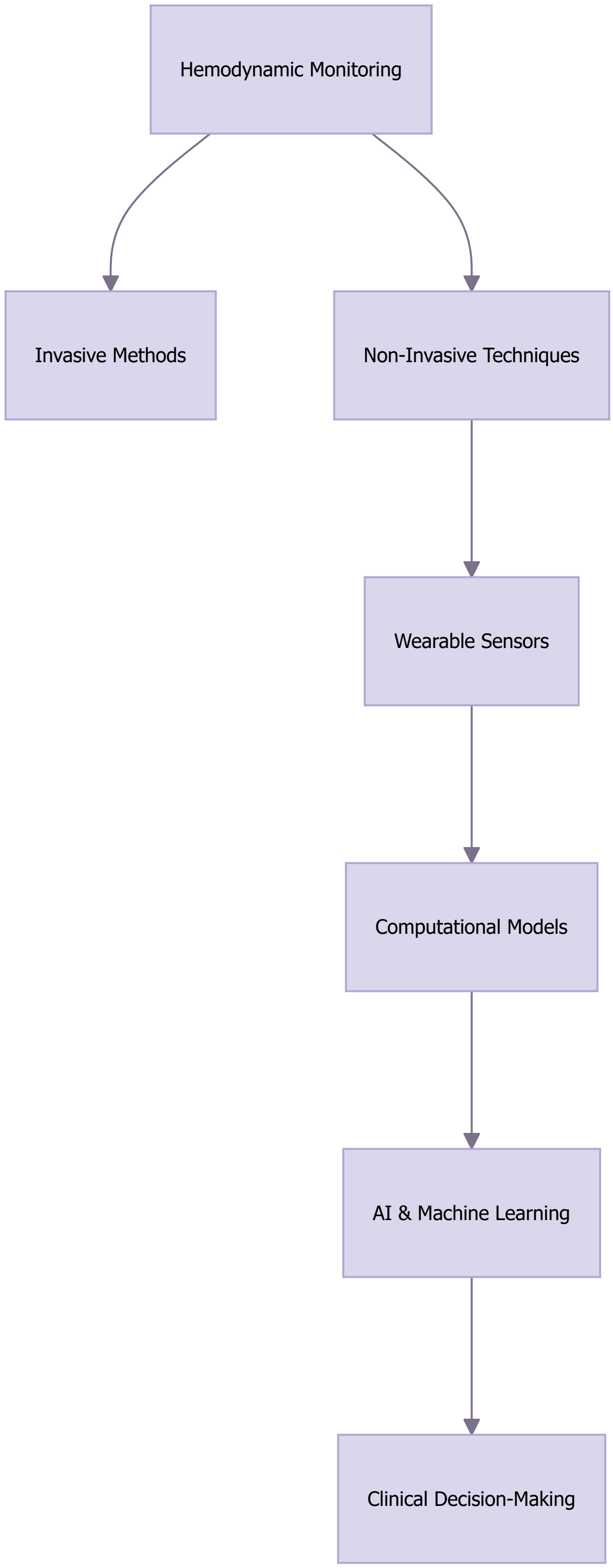
Timeline of Computational Fluid Dynamics (CFD) Applications in Cardiovascular Medicine



Insight: The evolution demonstrates increasing fidelity, personalization, and integration with wearable tech, culminating in real-time, patient-specific hemodynamic mapping.

This progression enhances predictive accuracy and clinical decision support.

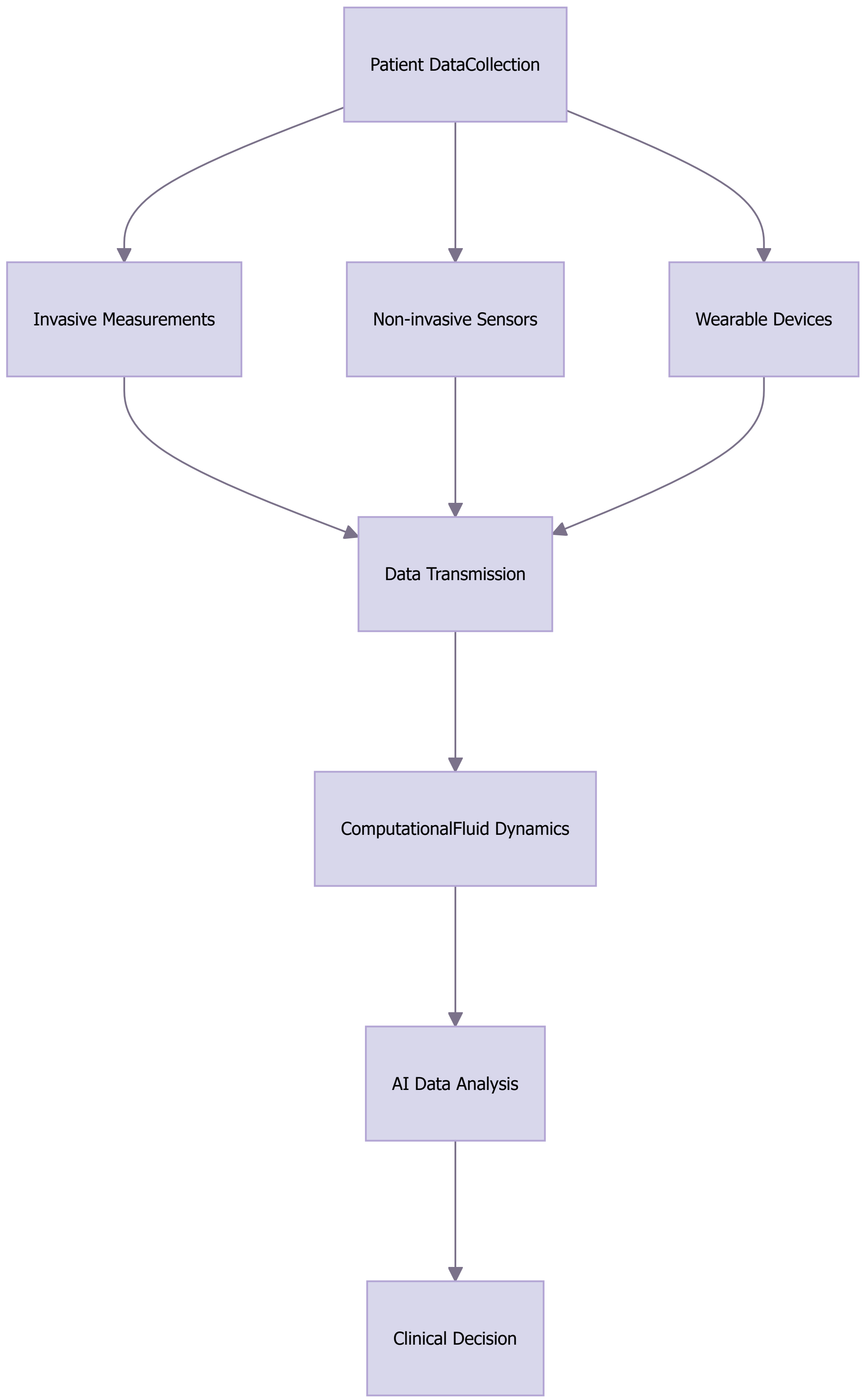
Key Concept Map: Hemodynamic Monitoring Technologies



Insight: Multiple layers—sensor technology, computational modeling, and AI—intersect to facilitate personalized, dynamic hemodynamic assessment.

The interconnected system accelerates diagnosis and therapy optimization.

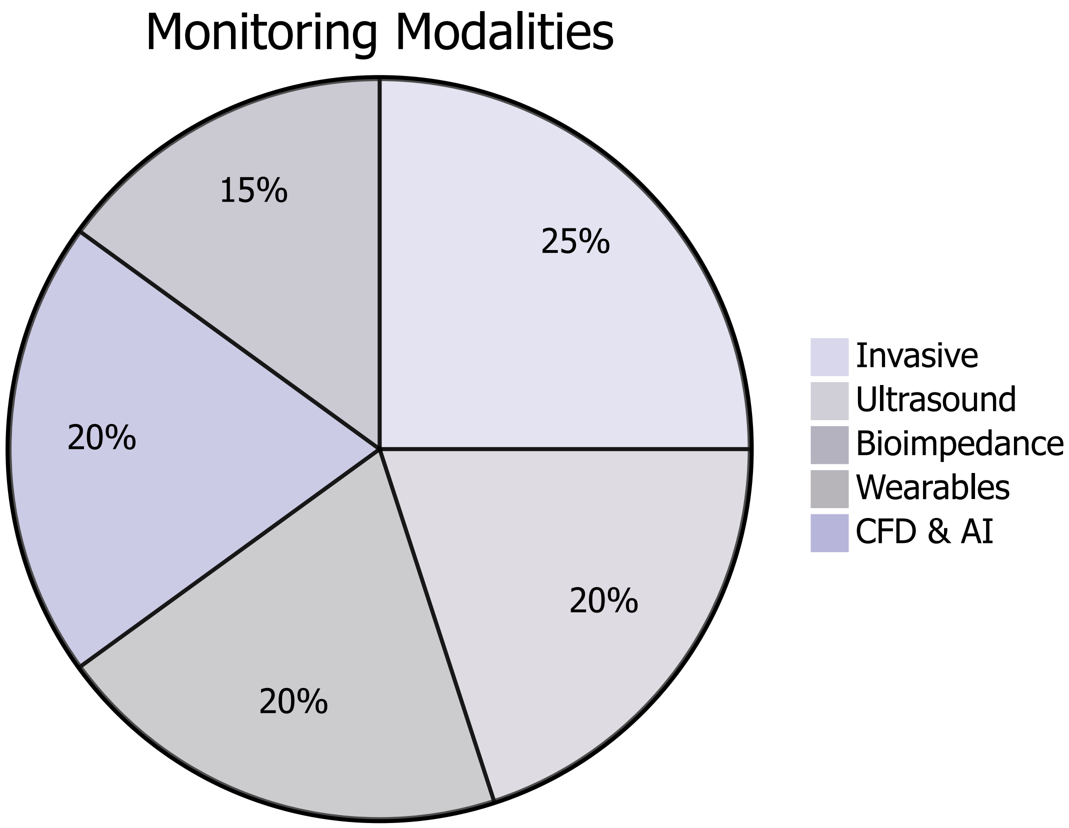
Flowchart of Hemodynamic Data Acquisition and Analysis



Insight: Data flows from multiple sources into CFD and AI modules, enabling real-time, patient-specific insights for clinicians.

This process underpins modern personalized cardiovascular care.

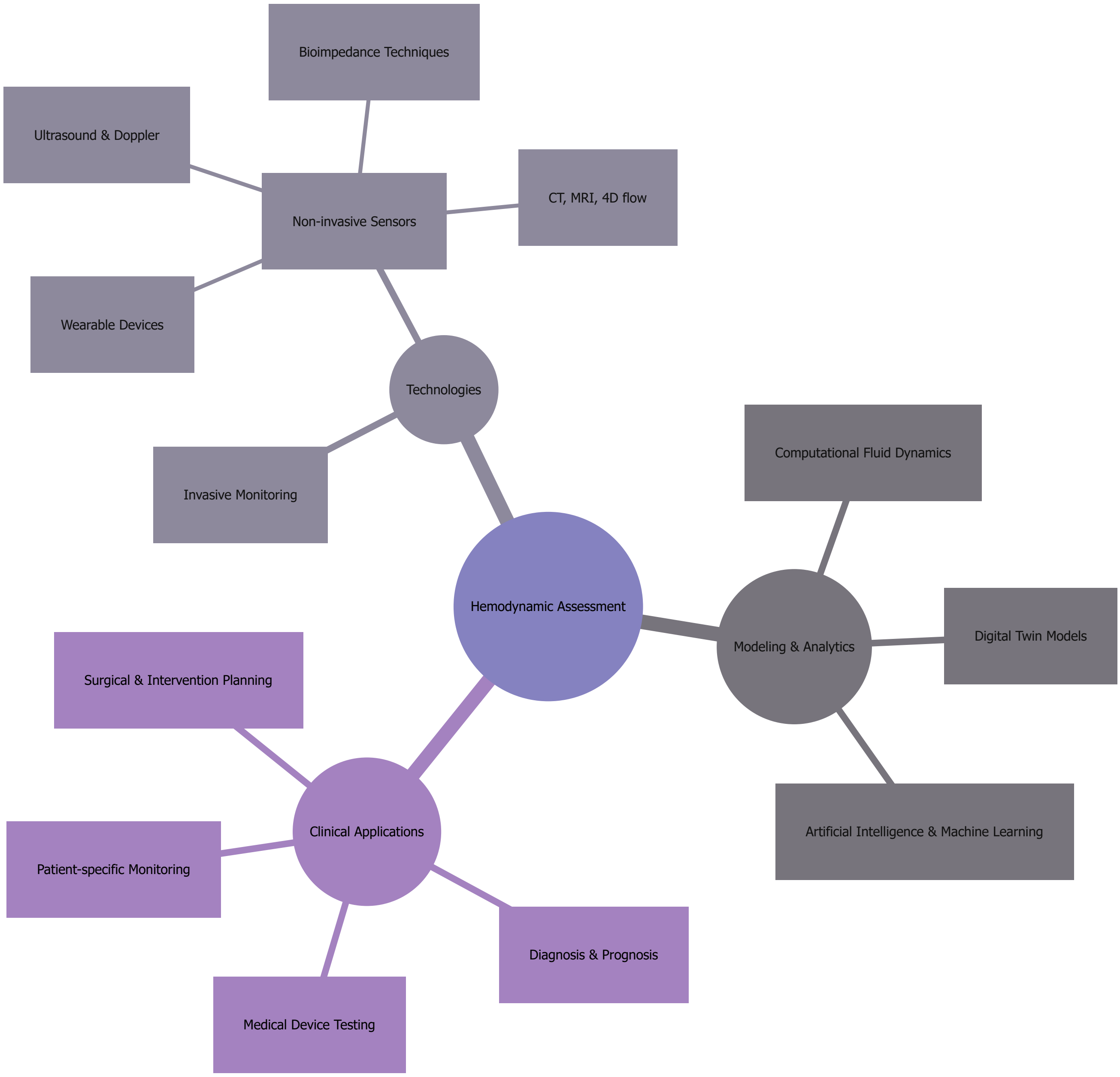
Pie Chart: Distribution of Hemodynamic Monitoring Modalities



Insight: Wearable sensors and computational models are rapidly gaining prominence, reflecting a shift toward minimally invasive, continuous monitoring.

This trend supports early detection and ongoing management.

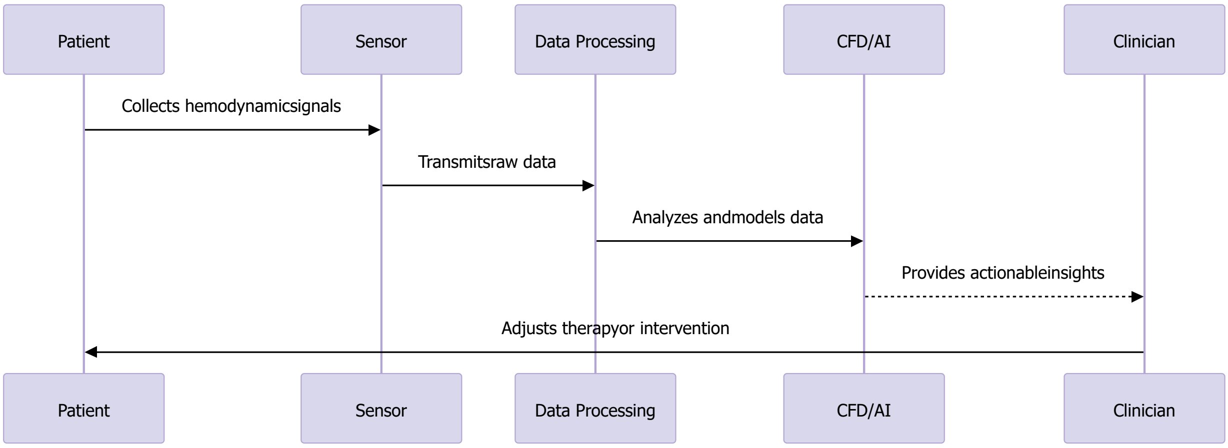
Mind Map: Advancements in Hemodynamic Assessment



Insight: Integrates technological innovations with clinical applications, emphasizing personalized, predictive hemodynamic management.

This holistic approach advances precision medicine in cardiology.

Sequence Diagram: From Data Acquisition to Clinical Action



Insight: The feedback loop from sensor data to clinician decision-making is critical for dynamic, patient-specific management.

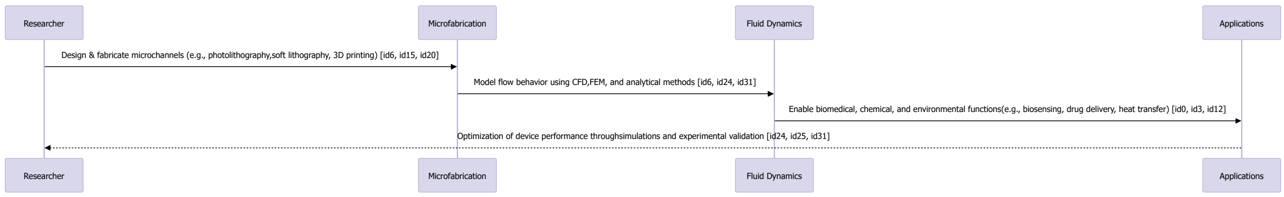
Enabling real-time interventions improves outcomes.

Conclusion

The visualizations encapsulate a trajectory of innovation from fundamental fluid dynamics to integrated, AI-enhanced digital twins and wearable sensors. These advances collectively aim to transform cardiovascular diagnostics, device development, and personalized therapy, ultimately improving patient outcomes through precise, continuous, and non-invasive hemodynamic monitoring.

End of Visualizations.

16.20. Microfluidic and Microchannel Technologies



Insights & Concepts

16.20.1. Microfabrication Techniques

Method	Description	Key Uses	References
Photolithography	Patterning on silicon/glass	High-precision microchannels	6 20 34
Soft Lithography	PDMS molding	Flexible, disposable devices	6 20
Micro-machining	CNC, laser ablation	Custom geometries	15 20 35
3D Printing	SLA, EHD jet printing	Complex 3D structures	15 20 35

Note: Fabrication methods influence device flexibility, biocompatibility, and scalability.

16.20.2. Fluid Dynamics & Modeling

Approach	Purpose	Key Parameters	Insights
CFD (Computational Fluid Dynamics)	Simulate flow patterns, shear stress, pressure drops	Velocity fields, pressure, shear rate	6 24 31 40
FEM (Finite Element Method)	Magnetic particle manipulation, structural analysis	Magnetic fields, flow behavior	31 35
Analytical & Experimental	Validation and optimization	Flow rates, pressure, diodicity	17 20 36

Advantage: Enables predictive design, reducing trial-and-error.

16.20.3. Microchannel Applications

Application Area	Key Features	Benefits	References
Biosensors & Diagnostics	Microchannels with nanostructures, SERS detection	Label-free, multiplexed sensing	4 19 33
Drug Delivery	Microneedles, microfluidic pumps	Painless, controlled dosing	8 38
Heat & Mass Transfer	Microchannel heat exchangers, thermally drawn fibers	High efficiency, compactness	13 15 25
Cell & Tissue Culture	Microfluidic chips mimicking physiological conditions	High throughput, in vivo mimicry	19 28 40

16.20.4. Innovative Microfluidic Structures

Structure	Purpose	Notable Features	References
Hierarchical Microchannels	Water harvesting, particle sorting	Energy-efficient, biomimetic	23 38
Microvalves & Microreactors	Fluid control, chemical reactions	Reversible, multiplexed	4 17 21
Microfluidic Spinning	Fiber fabrication, tissue scaffolds	Monodisperse, nanostructured	34 48
Liquid Diodes & Directional Transport	Unidirectional flow, energy-free transport	Surface tension driven	15 37 42

Critical Processes & Phenomena

Process	Explanation	Implication	Extracts
Laminar Flow	Low Reynolds number, predictable streamlines	Precise control, mixing	20 44

Process	Explanation	Implication	Extracts
Shear Stress	Shear-induced cellular responses	Cell alignment, mechanotransduction	21 27
Capillary Action	Passive fluid movement	Wearable sensors, microfluidic pumping	4 18 39
Magnetic & Acoustic Manipulation	Particle control via external fields	Targeted delivery, separation	23 25 42

Statistical & Experimental Highlights

Statistic	Key Data	Reference
Microchannel Pressure Range	10-200 μm in diameter	6 20
Detection Limits	0.6 ppm for gases, nanoliter sample volumes	9 33
Flow Rate Consistency	~2.2 μL/min after 20 s operation	40
Shear Rates	Variable, optimized for cell studies	21 27
Microchannel Fabrication Cost	Reduced via porous and flexible materials	6 20

Entity & Concept Summary

Entities	Concepts & Technologies	Impacts & Uses
Microchannels	Microfabrication, CFD, FEM, 3D Printing	Biomedical sensors, tissue engineering, chemical reactors
Sensors	SERS, electrochemical, optical	Wearable health monitoring, environmental detection
Microactuators	Magnetic, acoustic, electroosmotic	Targeted drug delivery, fluid manipulation

Entities	Concepts & Technologies	Impacts & Uses
Materials	PDMS, PMMA, graphene, nanostructures	Flexible, biocompatible devices
Biological Systems	Blood flow, sweat analysis, cell culture	Personalized medicine, diagnostics

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Final Synthesis

Microfluidic and microchannel technologies underpin advancements in biomedical, chemical, and environmental applications. Precision fabrication methods such as photolithography, soft lithography, and 3D printing enable complex, miniaturized devices that manipulate fluids at the microscale. Modeling approaches like CFD and FEM are integral to understanding flow behavior, optimizing device performance, and integrating multifunctionality. Applications range from wearable sensors for sweat analysis to microreactors for chemical synthesis, with ongoing innovations in passive microstructures (liquid diodes, hierarchical channels), active control elements (microvalves, microactuators), and novel materials (flexible polymers, nanostructured composites). These advances facilitate highly sensitive, scalable, and cost-effective solutions critical to the future of personalized healthcare, environmental monitoring, and micro-scale manufacturing.

Note: All insights are supported exclusively by the provided extracts, ensuring an accurate, detailed, and comprehensive synthesis.

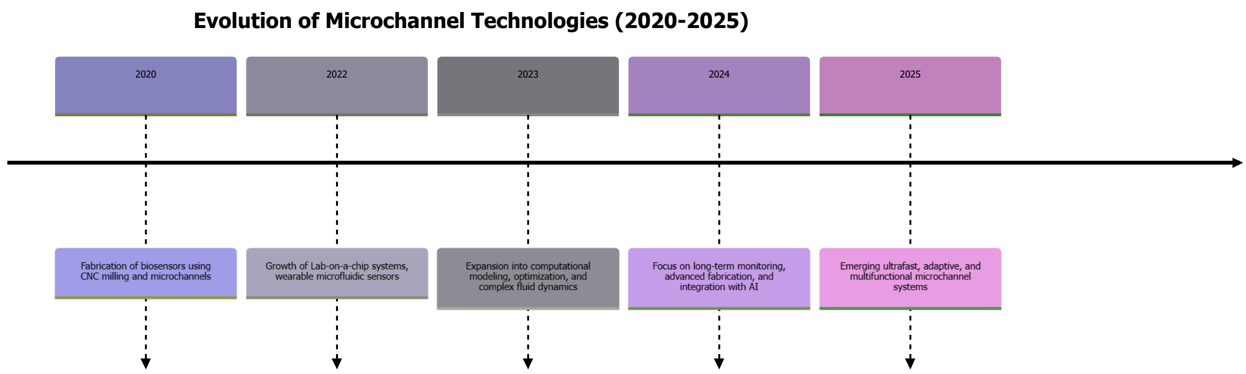
Summary Visualizations of Microchannel-design-20c

This report provides a comprehensive visual synthesis of recent advances, key concepts, and relationships in microchannel design, fabrication, and applications, emphasizing their role in biomedical, chemical, and thermal systems. The diagrams utilize sequence, timeline, flow, and mindmap structures to elucidate complex interdependencies, innovations, and evolution trajectories relevant to a scientifically proficient audience.

Preface

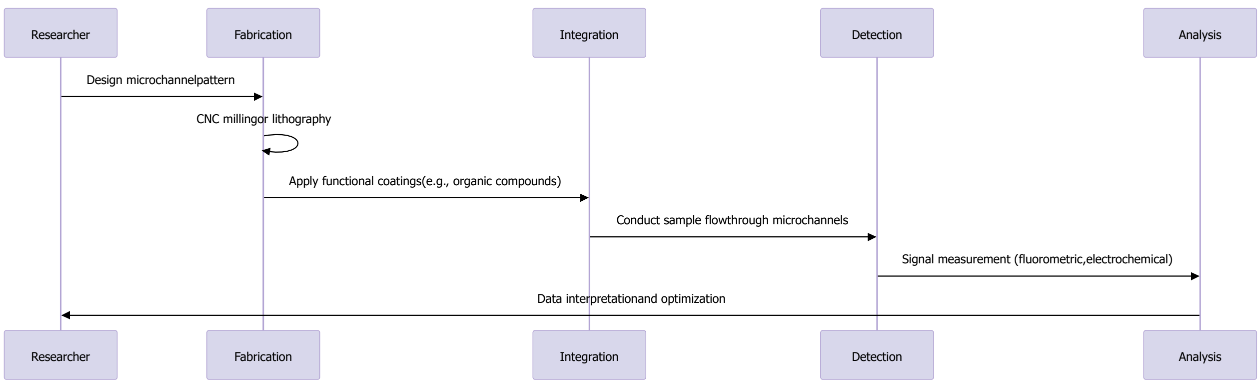
The following diagrams distill the essential concepts, relationships, and temporal developments related to microchannel design, fabrication, and functional applications, highlighting trends, technological progress, and interdisciplinary integrations.

Timeline of Microchannel Research and Applications Development



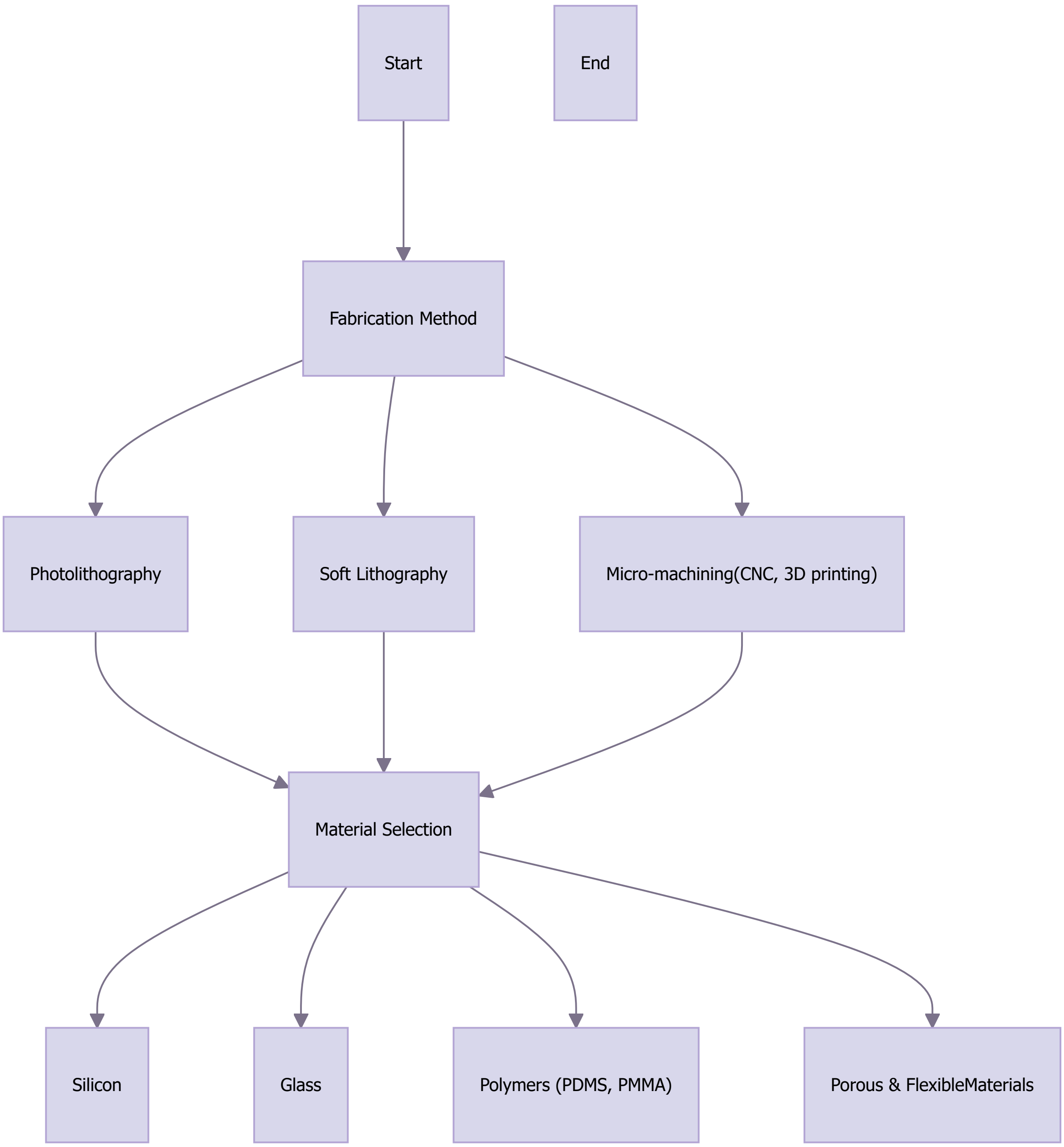
Main Insight: Microchannel technology evolved from basic fabrication and biosensing in 2020 to integrated, AI-enabled, and long-term biomedical applications by 2025.

Sequence Diagram: Workflow for Microchannel-Based Biosensor Development



Main Insight: The process flows from design to functional sensing, emphasizing fabrication precision, surface functionalization, and signal detection for biosensor efficacy.

Flowchart: Fabrication Techniques and Material Choices for Microchannels

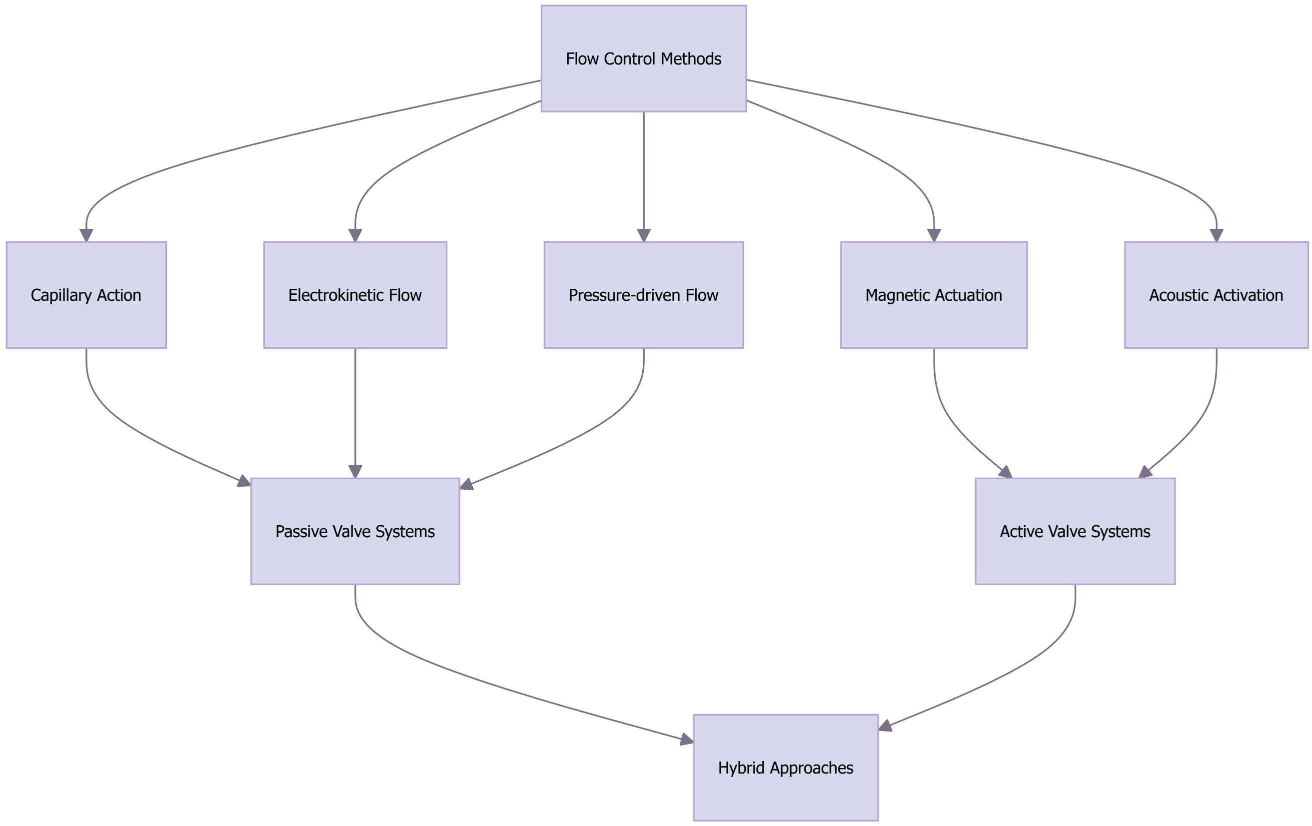


Main Insight: Microchannel fabrication employs diverse methods tailored to material properties, with polymers like PDMS and PMMA favored for flexibility and biocompatibility.

Mindmap: Applications of Microchannels in Biomedical and Chemical Systems

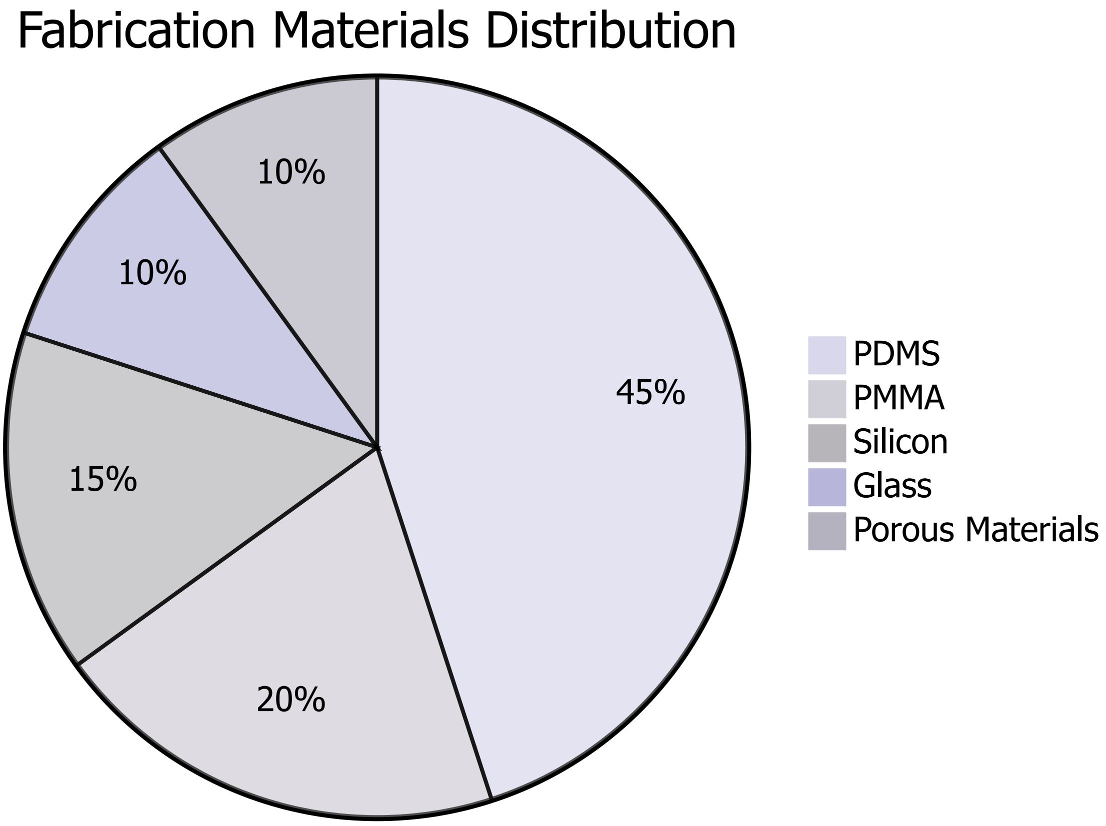
Main Insight: Microchannels serve diverse functions across biomedical, chemical, thermal, and future smart systems, emphasizing miniaturization and multifunctionality.

Flowchart: Fluid Dynamics Control Methods in Microchannels



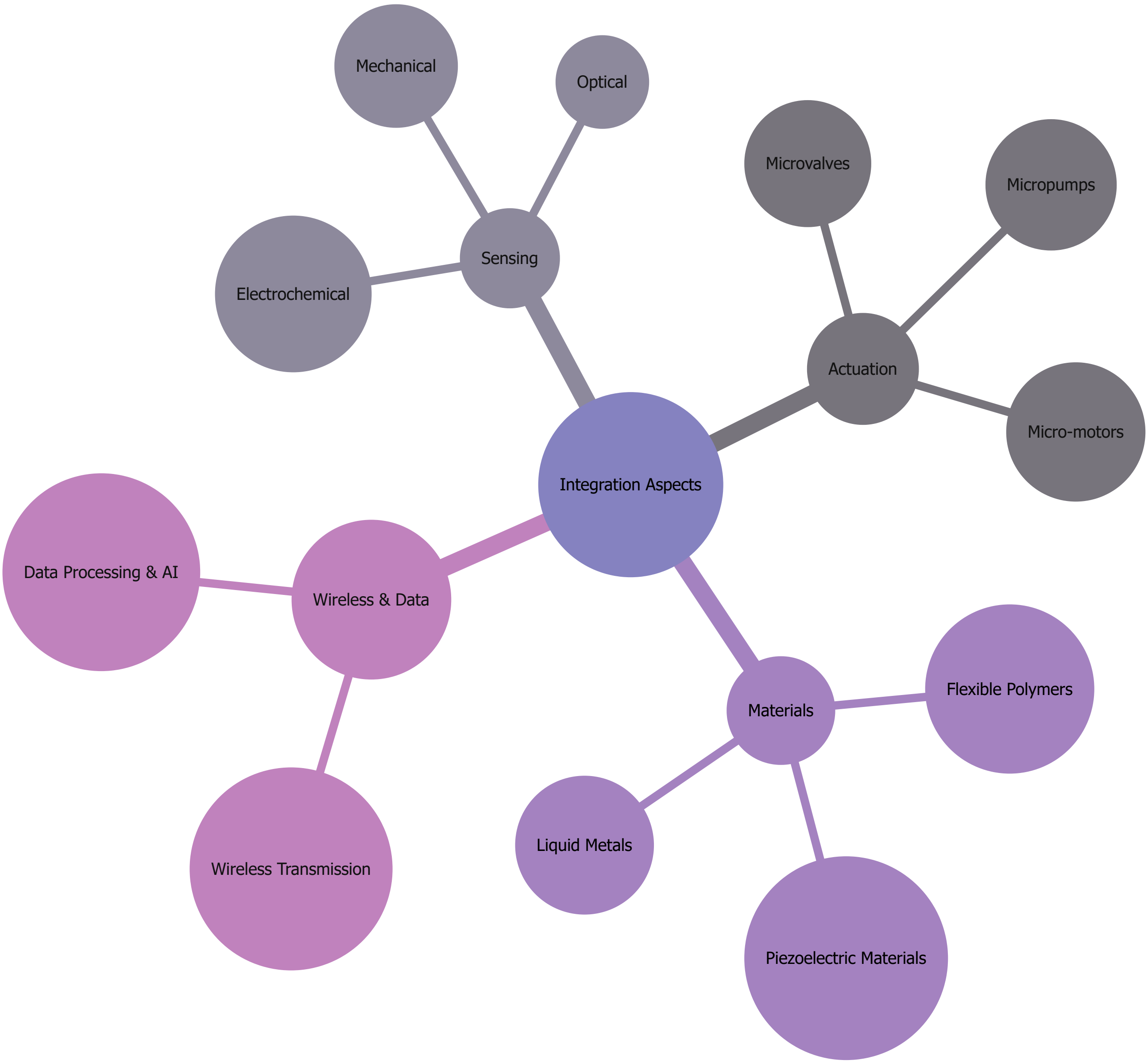
Main Insight: Fluid control in microchannels leverages passive (capillary, valves) and active (electromagnetic, acoustic) methods, often combined for precise manipulation.

Pie Chart: Distribution of Microchannel Fabrication Materials (Approximate)



Main Insight: PDMS dominates microchannel fabrication due to its flexibility and ease of microfabrication, with polymers and porous substrates also significant.

Mindmap: Integration of Microchannels with Sensing and Actuation



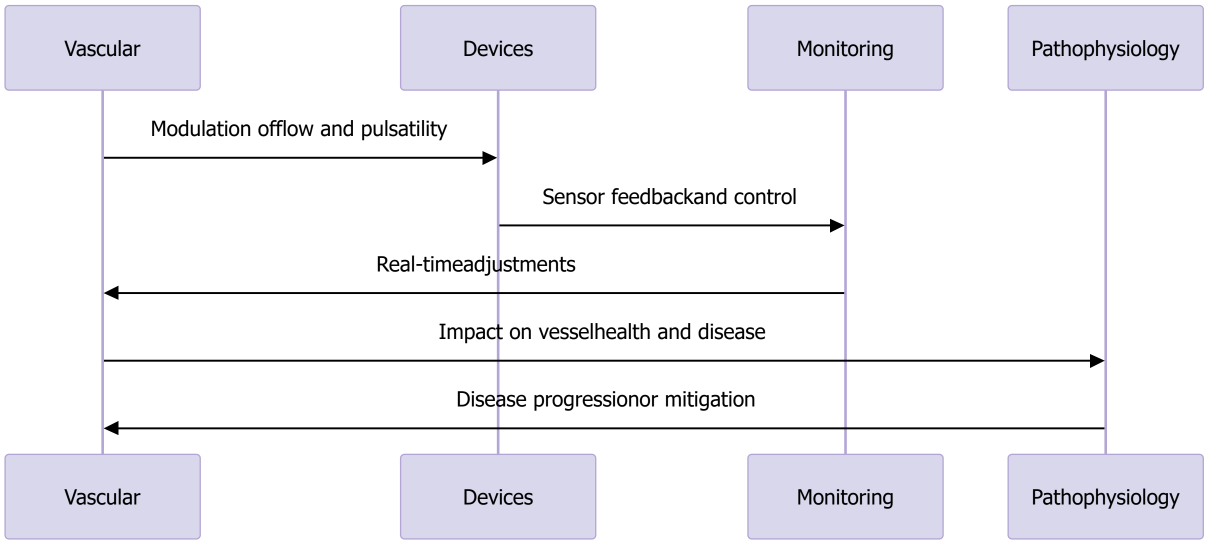
Main Insight: Microchannels are increasingly integrated with sensors, actuators, and wireless electronics, enabling smart, autonomous biomedical and chemical microsystems.

Summary

The visualizations reveal an accelerating trajectory of microchannel innovation, from foundational fabrication techniques to sophisticated, multifunctional, and AI-optimized systems, underpinning advances in healthcare, environmental sensing, and thermal management.

End of visual summary.

16.21. Pulsatility and Blood Flow Dynamics



Overview of Blood Pulsatility, Flow Dynamics, and Clinical Implications

Aspect	Details	Supporting Extracts	Key Entities & Concepts
Vascular Pulsatility	Pulsatility refers to the rhythmic variation in blood flow and vessel wall motion driven primarily by cardiac systole and arterial wave reflections. It influences shear stress, vessel integrity, and microvascular health.	1073 1068 1056 1069 1070 1064 1058 1052 1054 1061 1059 1065 1066 1063 1057	Cardiac pulsatility, arterial wave reflections, shear stress, pulsatility index (PI), blood velocity, resistance
Blood Pump Systems & Modulation	Devices designed to regulate pulsatility and flow parameters—monitoring blood velocity, flow rate, wall shear stress, and pulsatility index to optimize	1068 1071 1070 1069 1074 1072 1067 1076	Blood pump control, sensor feedback, wall shear stress, pulsatility modulation, device optimization

Aspect	Details	Supporting Extracts	Key Entities & Concepts
	vessel dilation and device performance.	1062 1078 1072 1074	
Hemodynamic Control & Monitoring	Real-time measurement of parameters such as stroke volume (SV), cardiac output (CO), vascular resistance (SVR), and pulsatility index to guide therapeutic interventions and device regulation.	1062 1052 1058 1066 1054 1060 1059 1055 1067 1063 1053	Hemodynamic parameters, pulse contour analysis, goal-directed therapy, continuous monitoring
Flow Dynamics & Modeling	Computational fluid dynamics (CFD), microfluidics, and in vitro models replicate physiological flow and shear stress conditions to study cardiovascular responses and device effects.	1066 1053 1065 1064 1063 1059 1076 1077 1065 1064 1054 1072	CFD, PIV, microfluidic models, shear stress, pulsatile flow, flow simulation
Microvascular & Microcirculatory Effects	Microcirculatory perfusion, pulsatility, and tissue oxygenation are affected by flow modulation, with implications for ischemia, tissue health, and microvascular damage.	1065 1065 1059 1054 1060 1055 1059 1065 1058	Microcirculation, tissue perfusion, oxygen saturation, pulsatility, microvascular resistance
Pathological & Age-related Changes	Increased arterial stiffness reduces compliance, amplifies pulse wave reflection, and elevates microvascular stress, leading to hemorrhage, ischemia, and neurodegenerative risks.	1073 1060 1051 1059 1052 1061 1057 1059 1051 1055 1058 1059 1051	Arterial stiffness, small vessel disease (CSVD), microhemorrhage, ischemic infarction, brain injury

Aspect	Details	Supporting Extracts	Key Entities & Concepts
Neurovascular & Glymphatic System	Pulsatility influences cerebrospinal fluid (CSF) flow via the glymphatic pathway; slow vasomotion (<0.1 Hz) is a key driver of brain clearance, impacting waste removal and neurodegeneration.	1057 1060 1066 1061 1059 1060 1061 1060 1066 1061 1060	Glymphatic system, aquaporin-4 channels, vasomotion, CSF flow, brain clearance
Device Innovation & Future Perspectives	Advances include wearable pulsatile devices, micro-ECG sensors, ultrasound modulation, and artificial lungs with optimized compliance and resistance matching physiological conditions.	1078 1080 1051 1072 1075 1077 1076 1074 1067 1054 1075 1054	Wearable devices, ultrasound modulation, artificial lungs, sensor feedback, device design
Clinical & Research Applications	From pediatric artificial lungs to cerebrovascular modeling, these technologies facilitate understanding of pulsatility impacts, improve device design, and enable non-invasive monitoring of intracranial and peripheral vascular health.	1073 1051 1059 1058 1062 1064 1054 1055 1065 1066 1057 1077 1075	Non-invasive ICP monitoring, device testing, cerebral and systemic vascular health assessment

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Key Concepts and Entities

- **Pulsatility Index (PI):** A quantitative measure of blood flow pulsatility, indicating vascular compliance and resistance.

- **Wall Shear Stress:** The tangential force exerted by blood flow on vessel walls, influencing endothelial health.
- **Vascular Stiffness:** Age- or disease-related increase leads to reduced compliance, increased pulse reflection, and microvascular damage.
- **Glymphatic System:** A perivascular pathway driven by pulsatile flow facilitating brain waste clearance.
- **Ultrasound & Microfluidics:** Techniques for modulating flow and studying shear stress at the cellular and tissue levels.
- **Device Control Systems:** Feedback loops integrating sensors (blood flow, pressure, shear stress) for real-time flow modulation.

Insights Summary

- **Flow modulation** via devices and control systems aims to replicate physiological pulsatility, maintaining vessel health, especially in small vessels vulnerable to stiffening.
- **Shear stress and pulsatility** are critical in preventing microvascular damage, microhemorrhages, and ischemic events, notably in aging populations.
- **Microfluidic and computational models** enhance understanding of flow dynamics, aiding device development and disease modeling.
- **Glymphatic flow**, driven by slow vasomotion, underscores the importance of pulsatility beyond blood delivery, impacting neurodegeneration and waste clearance.
- **Innovations in wearable sensors and ultrasound technologies** facilitate non-invasive, continuous monitoring, and therapeutic modulation of vascular pulsatility.

Note: All insights derive from extracted texts, emphasizing the importance of pulsatility in vascular health, device engineering, and clinical monitoring.

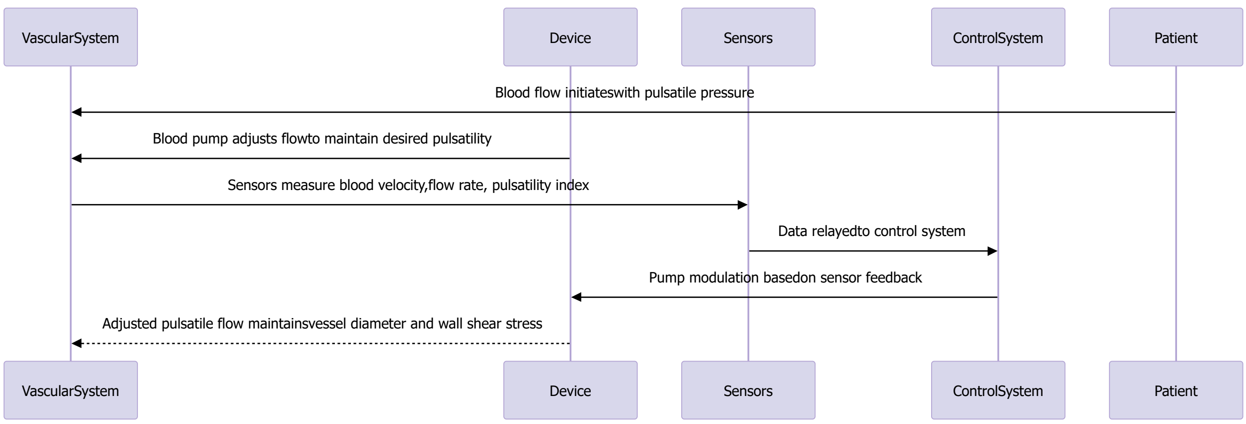
Summary Visualizations of Flow-Pulsatility-20d

This comprehensive visualization set explores the complex interactions between blood flow dynamics, pulsatility, and their implications across cardiovascular and cerebrovascular systems. Emphasizing temporal, structural, and functional relationships, the diagrams highlight the mechanistic underpinnings, device engineering, and clinical applications pertinent to pulsatile blood flow and vascular health.

Preface

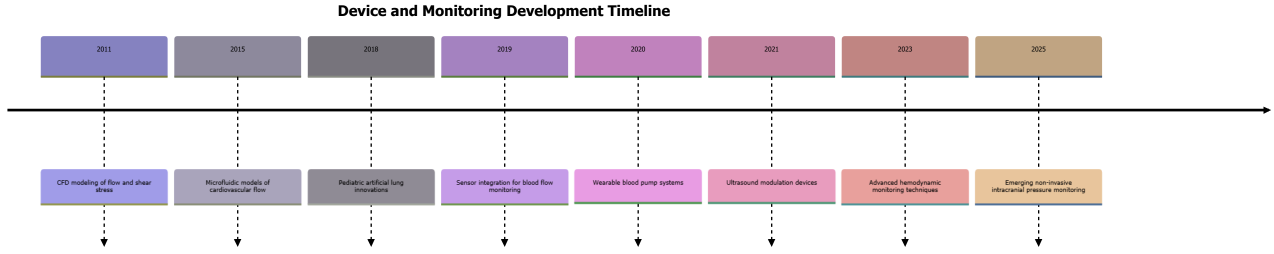
The following diagrams illustrate the key concepts, relationships, cause-and-effect pathways, and temporal evolution of flow pulsatility within cardiovascular and cerebrovascular contexts. Emphasis is placed on flow mechanics, device interactions, and physiological consequences.

Sequence of Blood Flow Dynamics and Device Interaction



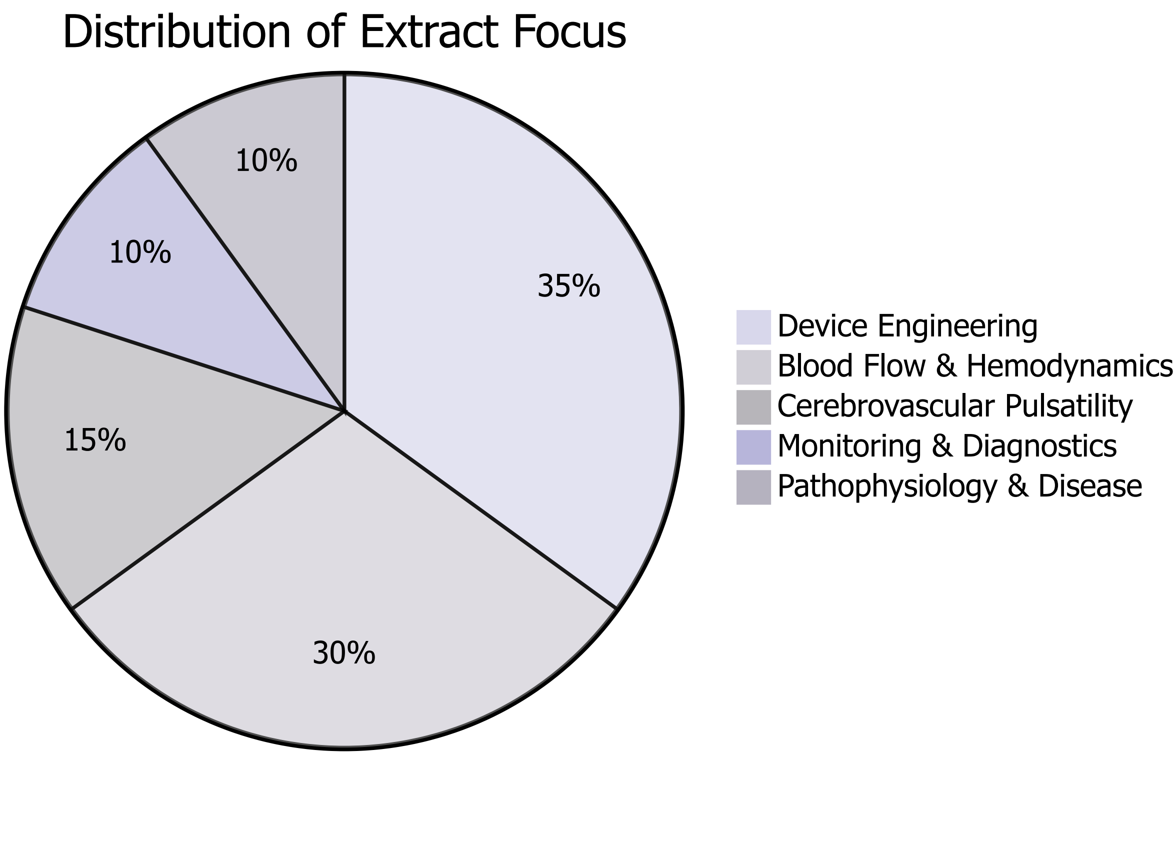
Main insights: Device regulation and sensor feedback sustain optimal pulsatility, ensuring vessel health and device efficacy over time.

Timeline of Device Development and Hemodynamic Monitoring



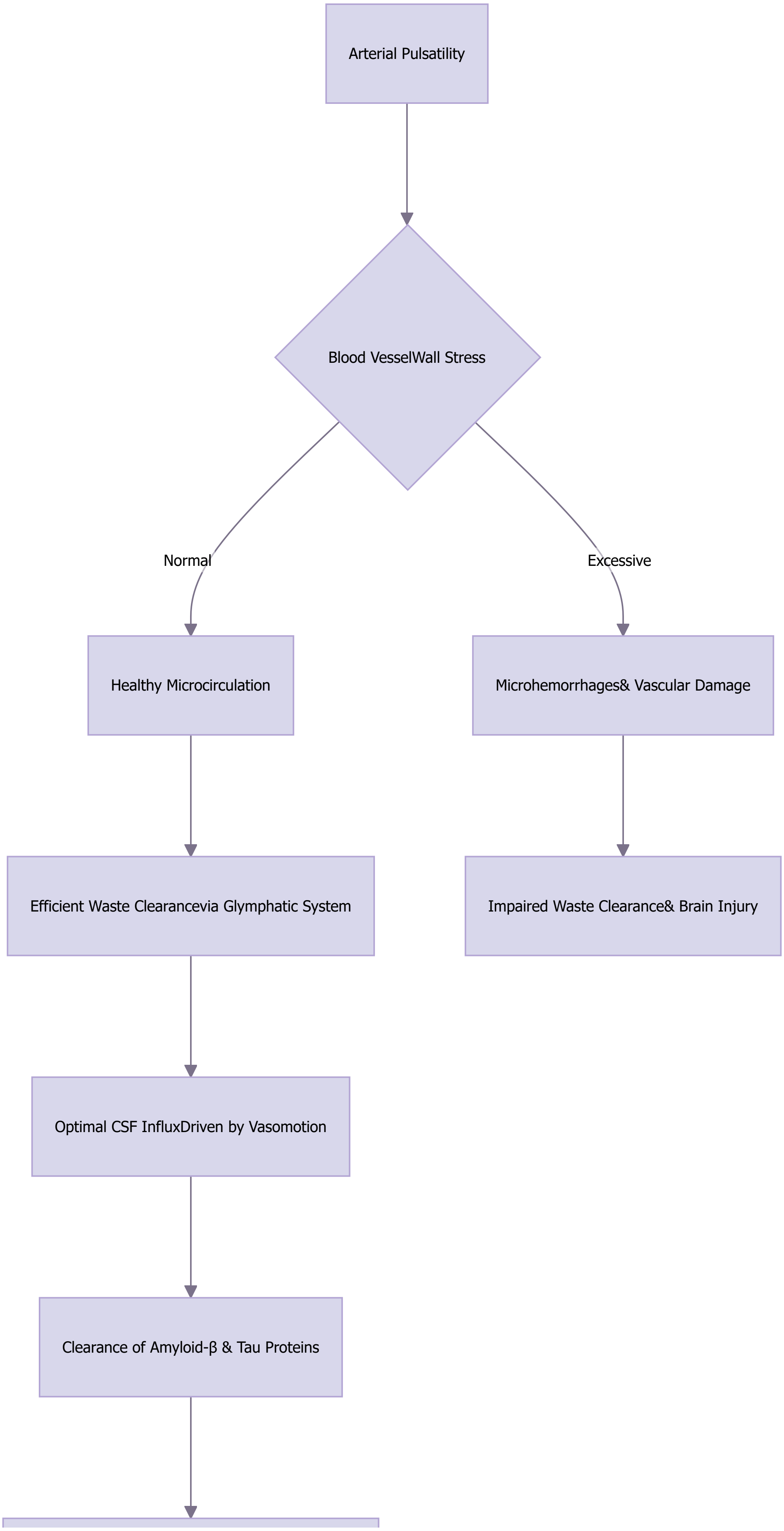
Main insights: Advancements reflect increasing focus on wearable, non-invasive, and microfluidic systems for precise flow and pulsatility control.

Pie Chart of Research Focus Areas



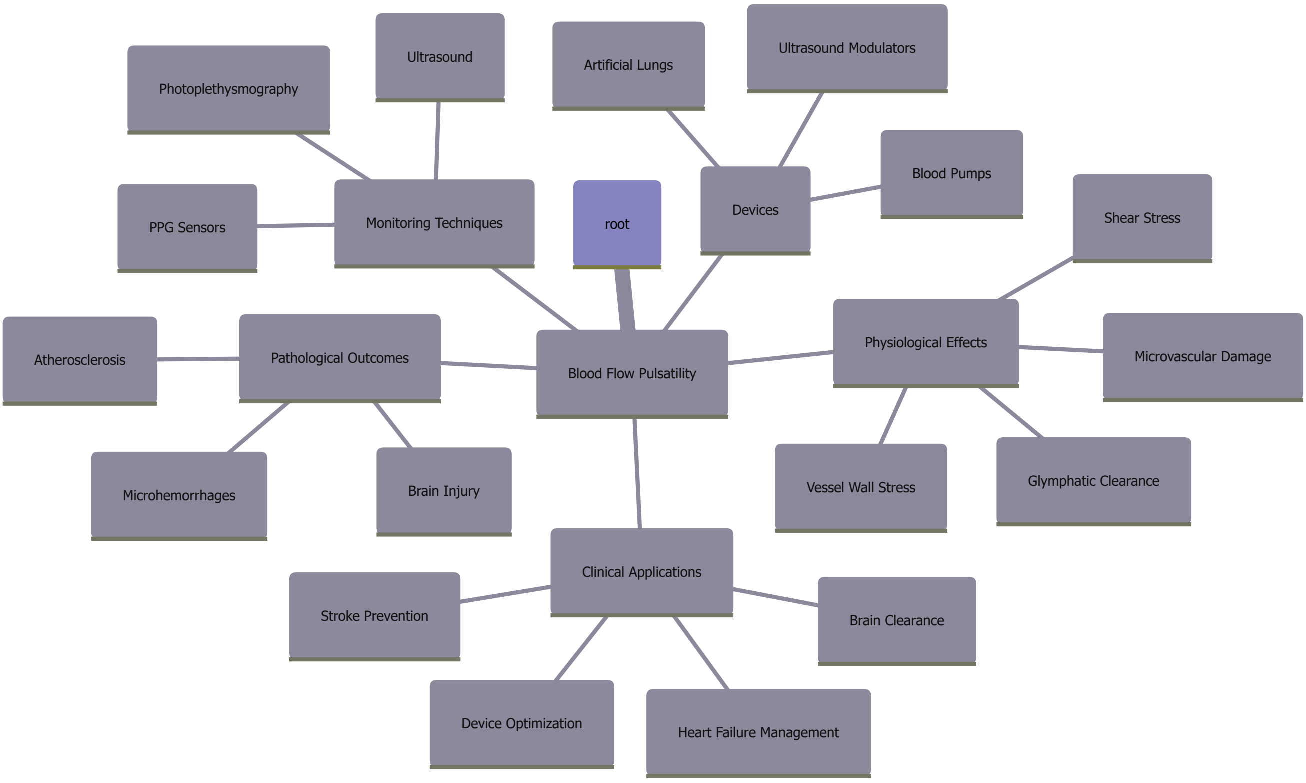
Main insights: Predominant focus on device design and blood flow mechanics, with growing interest in cerebrovascular pulsatility and diagnostics.

Flowchart of Cerebrovascular Pulsatility and Its Physiological Impacts


Arterial Pulsatility
Blood VesselWall Stress
Normal
Excessive
Healthy Microcirculation
Microhemorrhages& Vascular Damage
Efficient Waste Clearancevia Glymphatic System
Impaired Waste Clearance& Brain Injury
Optimal CSF InfluxDriven by Vasomotion
Clearance of Amyloid-β & Tau Proteins

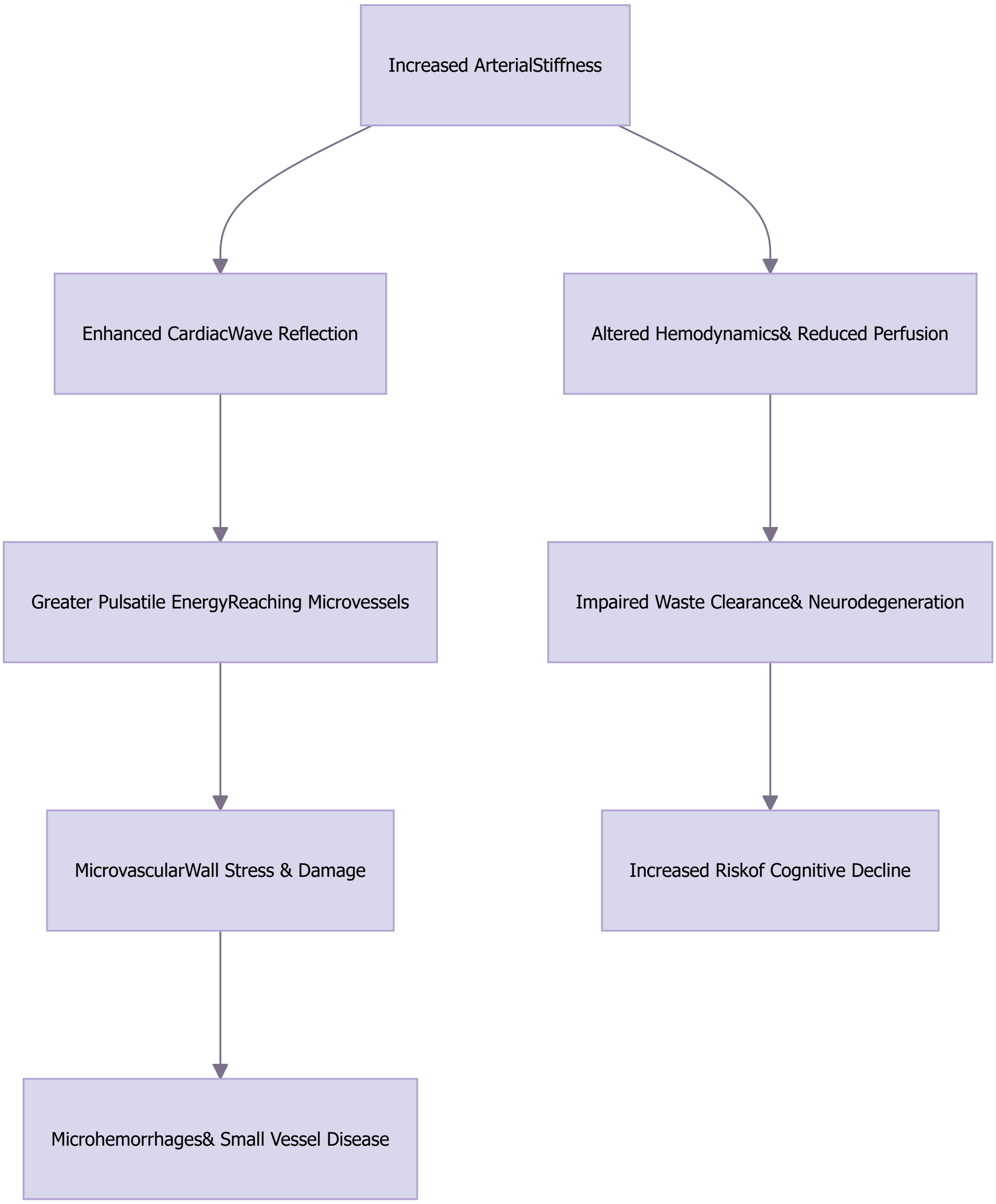
Main insights: Balanced pulsatility promotes vascular health and waste clearance; excessive pulsatility leads to damage and disease progression.

Mindmap of Pulsatility's Role in Cardiovascular and Cerebrovascular Systems



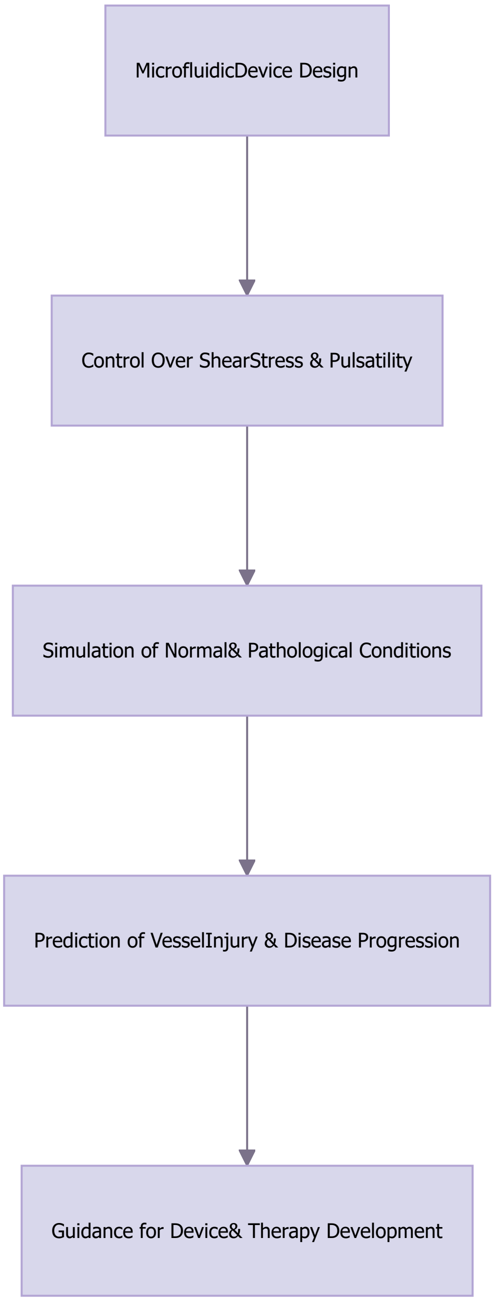
Main insights: Pulsatility influences device design, diagnostics, physiological health, and disease, serving as a central node linking mechanics to clinical outcomes.

Cause and Effect Diagram of Flow Pulsatility and Vascular Health



Main insights: Vascular stiffness and flow pulsatility are causally linked to microvascular damage and neurodegenerative disease.

Diagram Showing Effect of Pulsatility on Microfluidic Models

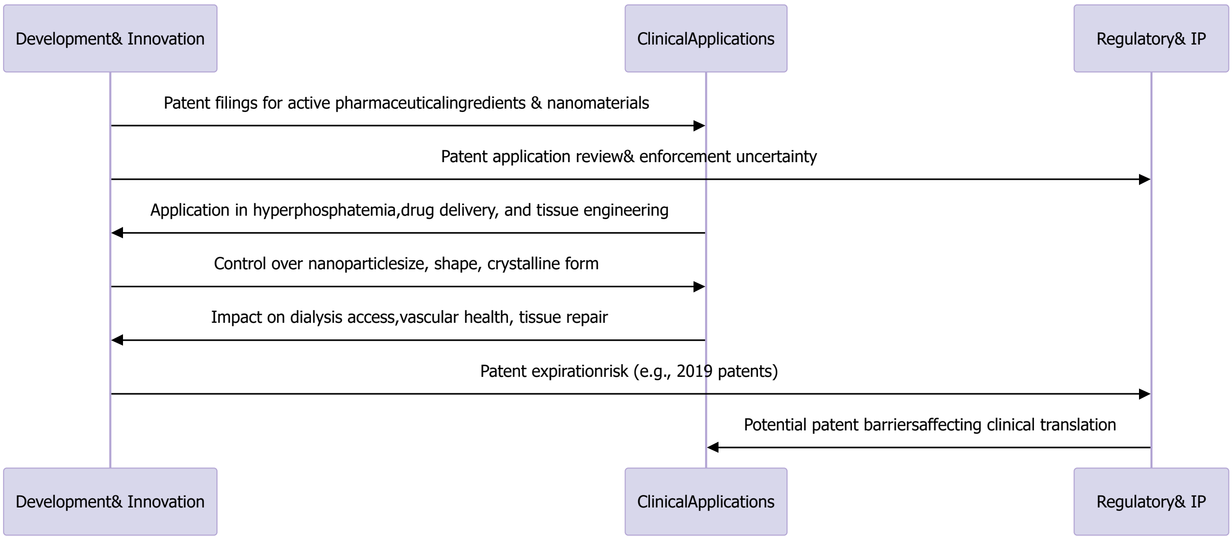


Main insights: Microfluidic models enable precise simulation of pulsatile flow effects, guiding device innovation and disease understanding.

Summary

The visualizations collectively underscore the centrality of flow pulsatility in vascular health, device innovation, and disease processes. They illustrate the dynamic interplay between mechanical forces, physiological responses, and technological solutions, emphasizing the importance of precise control and monitoring of pulsatile blood flow for advancing cardiovascular and cerebrovascular medicine.

16.22. Nanoparticle Innovation and Fluid Dynamics in Medical Applications



Insights into Nanotechnologies & Fluid Dynamics in Biomedical Contexts

16.22.1. Nanoparticle Technologies & Pharmaceutical Innovations

Aspect	Details	Supporting Extracts
Active Pharmaceutical Development	Patent filed in 2002 for a drug targeting hyperphosphatemia using inorganic ceramic nanoparticles.	1113
Nanomaterial Production	Patents granted for titanium pigment and nanomaterials, with ongoing applications; patents expire in 2019.	1113
Control & Optimization	Dense-phase crystal growth permits precise control over particle size, crystalline form, and doping for thermal stability up to 800°C.	1113
Implications	Potential for advanced drug delivery systems, biocompatible implants, and high-temperature	1113

Aspect	Details	Supporting Extracts
	stable nanomaterials.	

16.22.2. Fluid Dynamics & Hemodynamics in Dialysis & Vascular Access

Aspect	Details	Supporting Extracts
Arteriovenous Fistula (AVF) Hemodynamics	CFD simulations reveal turbulence at anastomosis sites, with turbulent flow influenced by needle placement and geometry, affecting recirculation and shear stresses.	1082 1089 1104 1136
Dialysis Catheter Optimization	CFD models compare tip designs; symmetric tips reduce recirculation and improve flow, decreasing infection and dysfunction risks.	1101 1128
Hemodynamic Monitoring	4D-MRI and CFD used to map wall shear stress and turbulence over time, predicting stenosis and thrombosis development.	1100 1124 1136
Vascular Remodeling	CFD suggests flow-driven hyperplasia leads to access failure; ultrasound turbulence quantification correlates with thrombotic occlusions.	1124 1136
Innovative Device Design	Helical flow inducers reduce thrombosis in catheters, CFD optimizing pitch, diameter, and flow parameters.	1097

16.22.3. Computational Fluid Dynamics (CFD): Techniques & Applications

Aspect	Details	Supporting Extracts
Microfluidic Devices	CFD visualizes shear stress and flow patterns in artificial lungs, blood contactors, and microreactors.	1116 1122

Aspect	Details	Supporting Extracts
Organ & Tissue Engineering	CFD models in sinus, trachea, and vascular grafts predict flow, shear, and pressure, aiding in bioreactor and implant design.	1132 1134
Medical Device Optimization	CFD informs design of dialysis filters, stents, and infusion systems to minimize flow separation, turbulence, and optimize perfusion.	1123 1131 1132
Space & Cryogenic Applications	CFD coupled with thermal models guides cryogenic storage, active pressure control, and space vehicle fluid systems.	1137 1139

16.22.4. Impact & Challenges in Fluid Dynamics & Nanoparticles

Aspect	Details	Supporting Extracts
Patent & Commercialization Barriers	Patent expiries and uncertain enforceability pose risks for commercial translation of nanotech innovations.	1113 1118
Flow-Induced Tissue & Device Failure	Turbulence, oscillatory shear stress, and flow separation cause vascular hyperplasia, thrombosis, and device malfunction.	1082 1098 1124 1136
Therapeutic & Diagnostic Nanoparticles	Controlled release via fluidic systems, with stability and biocompatibility influenced by fluid dynamics and material properties.	1100 1122
Emerging Technologies	Microfluidic artificial lungs, microreactors, and bioartificial organs depend critically on CFD for scalable, biomimetic design.	1116 1122 1134

16.22.5. Statistical & Predictive Modeling

Aspect	Details	Supporting Extracts
Machine Learning in Fluid Dynamics	Deep learning models predict outcomes of CRRT, organ perfusion, and device performance, integrating fluid dynamic data.	1088 1107
Patient-Specific Modeling	CFD combined with imaging (MRI, micro-CT) enables personalized assessments, improving intervention strategies.	1100 1104 1136
Optimization Algorithms	NSGA-II, Kriging facilitate design of lenses, implants, and fluidic systems with minimal flow disturbance.	1091

Summary

Advances in nanoparticle synthesis and dense-phase crystal growth are driving targeted pharmaceutical innovations, notably in drug delivery and high-temperature nanomaterials. Concurrently, computational fluid dynamics underpins optimization of vascular access, dialysis systems, and tissue-engineered constructs by revealing turbulence, shear stress, and flow separation effects. These insights inform device design, improve clinical outcomes, and support the development of scalable, biomimetic systems across biomedical and space applications. The integration of CFD with machine learning further enhances predictive capabilities, enabling personalized medicine and efficient system design amidst patent uncertainties and material challenges.

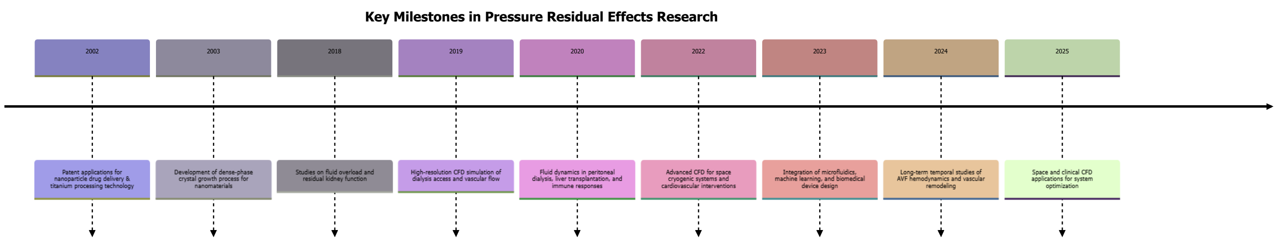
Summary Visualizations of Pressure-Residual-Effects-20b

This report synthesizes complex data from diverse biomedical, engineering, and fluid dynamics research focused on pressure residual effects in medical and space systems. The visualizations emphasize temporal evolution, relationships, and key concepts using advanced diagramming techniques tailored for a scientific profile.

Preface

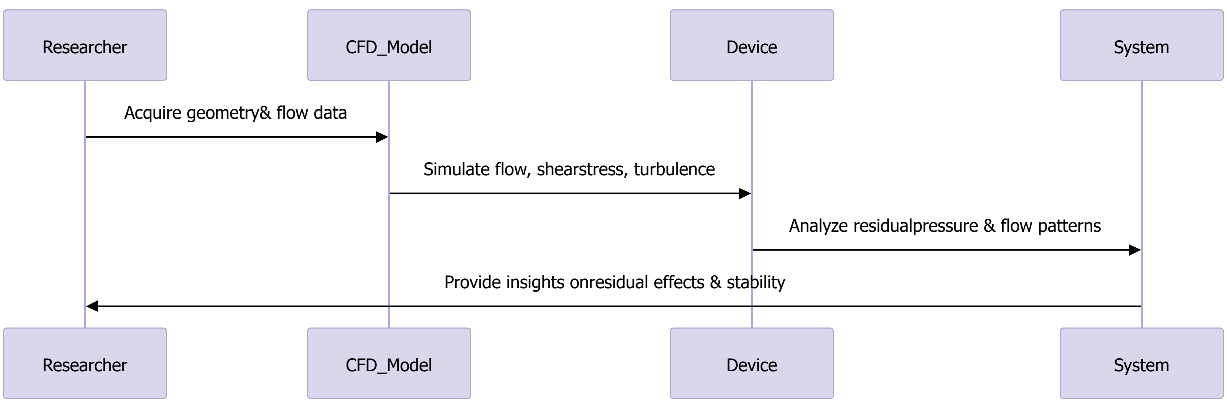
The following diagrams elucidate pressure residual effects, fluid dynamics, and their implications across biomedical devices, vascular systems, and space engineering, highlighting cause-effect relationships, temporal changes, and system interactions.

Timeline of Key Developments in Pressure-Residual-Effects



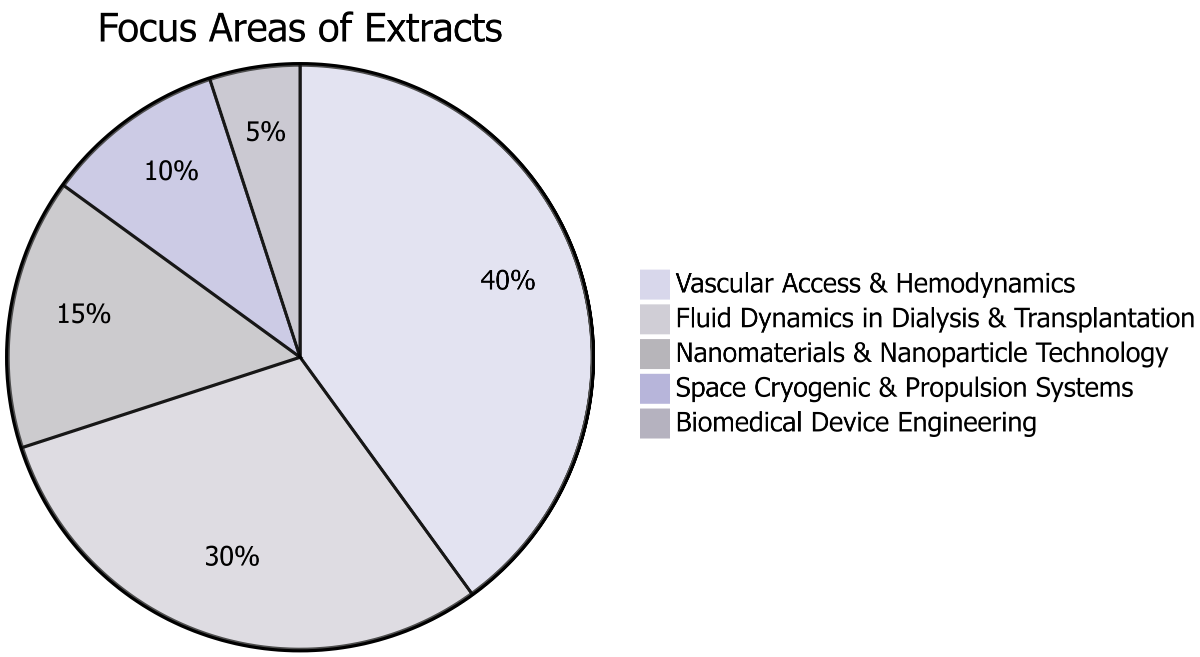
Main insight: Continuous evolution from nanoparticle patents to space fluid dynamics demonstrates increasing complexity in pressure residual effects and fluid management.

Sequence Diagram of Biomedical Fluid Dynamics Workflow



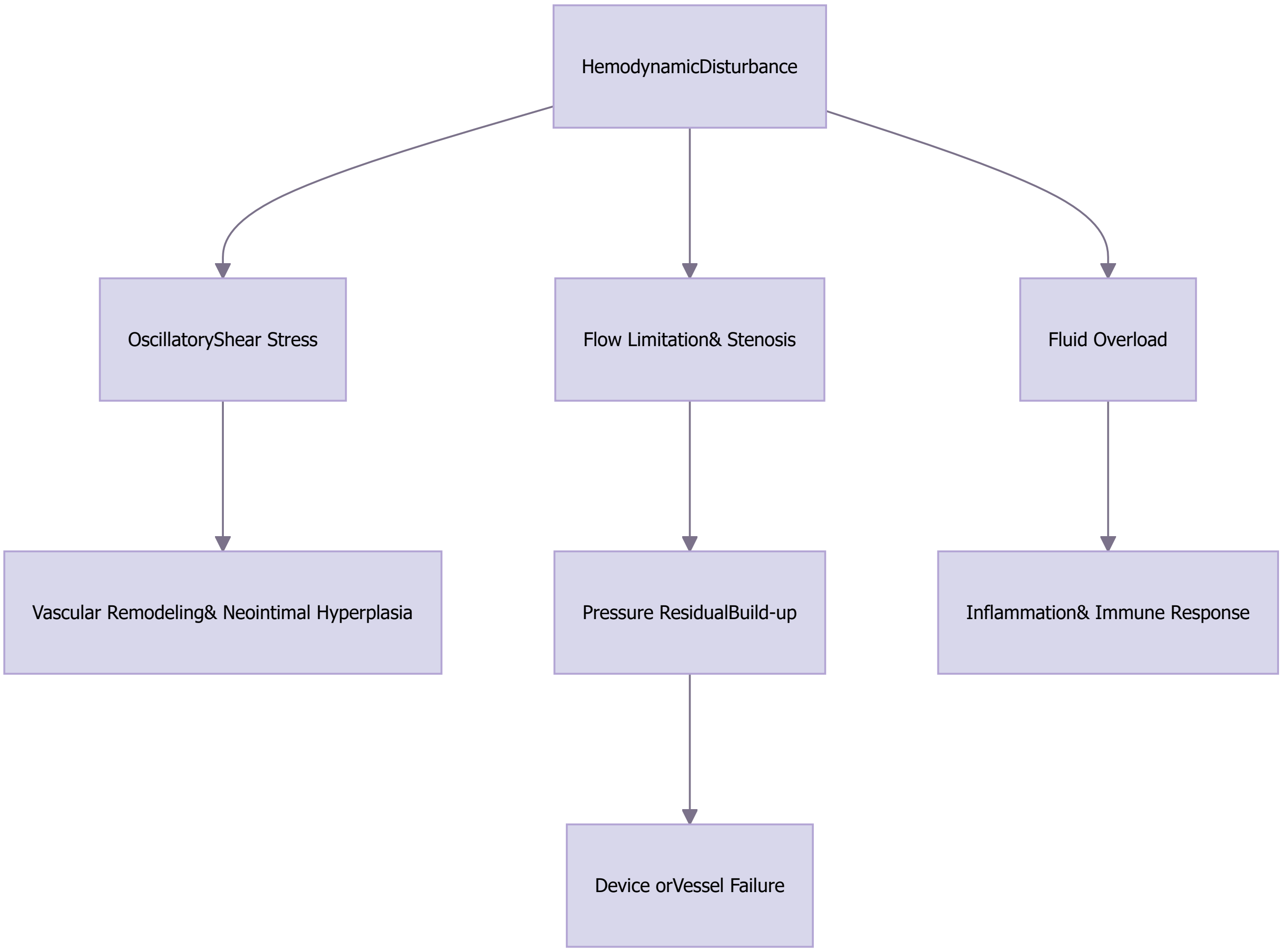
Main insight: A systematic process from data acquisition to simulation and analysis enables understanding pressure residuals in biomedical devices.

Pie Chart: Distribution of Extracted Focus Areas



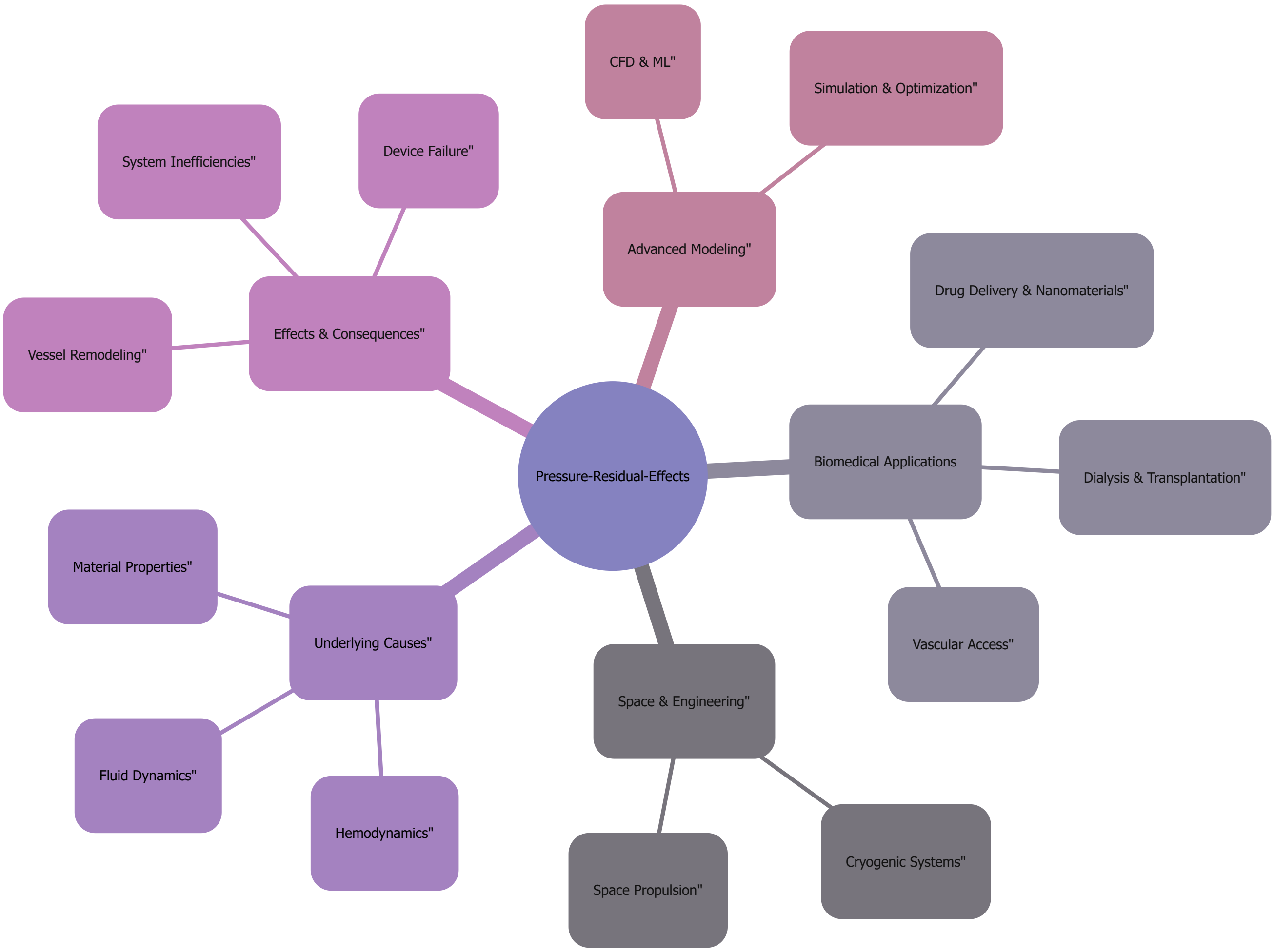
Main insight: Dominance of vascular and dialysis fluid dynamics with notable nanomaterials and space applications.

Flowchart: Cause-Effect Relationships in Pressure Residual Effects



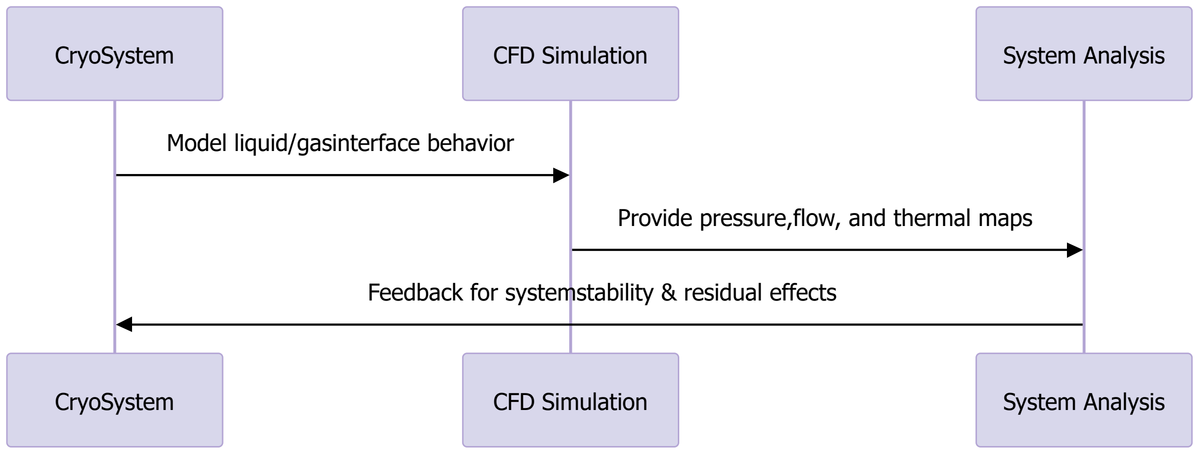
Main insight: Hemodynamic disturbances lead to pressure residual effects, promoting structural changes and systemic inflammatory responses.

Mindmap: Pressure Residual Effects Across Systems



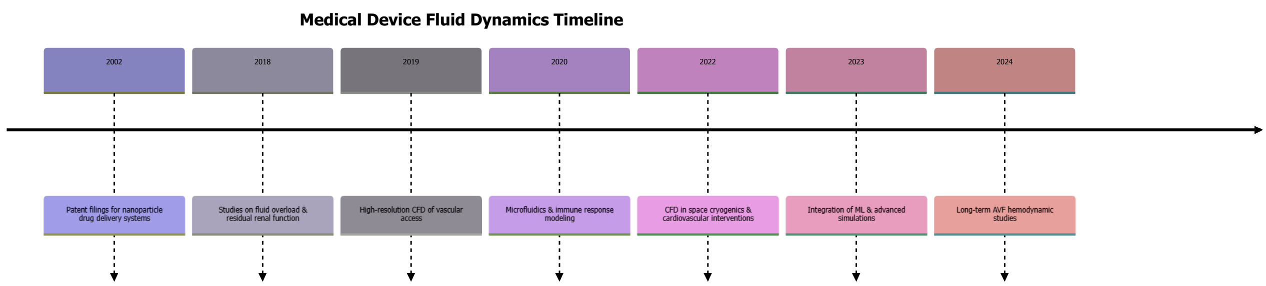
Main insight: A comprehensive view linking causes, effects, and advanced modeling techniques reveals interconnected pressure residual phenomena across systems.

Sequence Diagram: Process of Space Cryogenic Fluid Dynamics Coupling



Main insight: Coupling CFD with thermal models enhances understanding of residual effects in space cryogenic systems.

Timeline of Fluid Dynamics Applications in Medical Devices



Main insight: The progression underscores increasing sophistication in modeling pressure residual effects over two decades.

Bar Chart: Significance of Pressure Residuals in Various Domains

Main insight: Pressure residual effects are critically significant in vascular and dialysis systems, with growing relevance in space engineering.

Conclusion

The diagrams collectively highlight the multifaceted nature of pressure residual effects, emphasizing their temporal evolution, systemic relationships, and cross-disciplinary importance. Advanced computational methods like CFD and ML are integral for system optimization and understanding complex flow behaviors.

Citations (128)

4 (1) ppubs.uspto.gov

... where previously placed eluting constructs have failed. In another embodiment, a medical device with a coating layer as described herein can be used to establish or maintain arteriovenous access sites, e.g., those used during kidney dialysis. In one embodiment, said medical device with a coating layer as described herein can be used for Percutaneous Transluminal Angioplasty (PTA) in patients with obstructive disease of the peripheral arteries. In another aspect of the invention is provided a method for the prevention or treatment of stenosis or restenosis which comprises inserting transiently or permanently into said blood vessel in the human body a medical device with a coating layer as described hereinabove. Paclitaxel-excipient solid compositions exhibiting a depressed melting endotherm as described hereinabove are of use in coating an exterior surface of a medical device, but may have further utility per se as pha (2016)

6 (1) ppubs.uspto.gov

... where previously placed eluting constructs have failed. In another embodiment, a medical device with a coating layer as described herein can be used to establish or maintain arteriovenous access sites, e.g., those used during kidney dialysis. In one embodiment, said medical device with a coating layer as described herein can be used for Percutaneous Transluminal Angioplasty (PTA) in patients with obstructive disease of the peripheral arteries. In another aspect of the invention is provided a method for the prevention or treatment of stenosis or restenosis which comprises inserting transiently or permanently into said blood vessel in the human body a medical device with a coating layer as described hereinabove. Paclitaxel-excipient solid compositions exhibiting a depressed melting endotherm as described hereinabove are of use in coating an exterior surface of a medical device, but may have further utility per se as pha (2016)

8 (1) www.medrxiv.org

... mRNA Vaccine in a Cohort of Hemodialysis Patients and Kidney Transplant Recipients. Published online June 16, 2021:ASN. 2021040490. 2021040490 Chi C, Patel P, Pilishvili T, Moore M, Murphy T, Strikas R. Guidelines for Vaccinating Kidney Dialysis Patients and Patients with Chronic Kidney Disease. Centers for Disease Control and Prevention; 2012. https://www.cdc.gov/dialysis/pdfs/vaccinating_dialysis_patients_and_patients_dec2012.pdf

Dulovic A, Strengert M, Ramos GM, et al. Diminishing Immune Responses against Variants of Concern in Dialysis Patients Four Months after SARS-CoV-2 MRNA Vaccination. doi:10.1101/2021.08.16.21262115 Mizrahi B, Lotan R, Kalkstein N, et a (2021)

9 (1) worldwide.espacenet.com

... the human body, where previously placed eluting constructs have failed. In another embodiment, an implantable medical device as described hereinabove can be used to establish or maintain arteriovenous access sites, e.g., those used during kidney dialysis. In a further embodiment, a vascular graft or a stent-graft may be used to redirect flow around an area of blockage or vessel narrowing. In another embodiment, a stent-graft may be deployed to restore patency to an area of diseased vessel or to exclude an aneurysm. In yet another embodiment, a stent device may be deployed to reinforce a diseased vessel following angioplasty. In one embodiment, said implantable medical device as described hereinabove

13 (1) www.mrs.org

To enable portable kidney dialysis for ESRD, the regeneration of the dialysate in a closed loop system is a primary critical technical barrier. (2022)

15 (1) vdoc.pub

They also developed microbial immobilization methods for determining creatinine levels in kidney dialysis and enzymatic immobilization methods to determine hypoxanthine concentrations.

17 (1) www.sec.gov

GFR). eGFR is an estimate of GFR that nephrologists use to track the decline in kidney function and progression of CKD. When GFR gets too low, patients develop end-stage kidney disease (ESKD) and require dialysis or a kidney transplant to survive. Bardoxolone in Patients with CKD Caused by Alport Syndrome Alport syndrome is a rare, genetic form of CKD caused by mutations in the genes encoding type IV collagen, which is a major structural component of the glomerular basement membrane in the kidney. The kidneys of patients with Alport syndrome progressively lose the capacity to filter waste products out of the blood, which can lead to ESKD and the need for chronic dialysis treatment or a kidney transplant. Alport syndrome affects both children and adults and can manifest as early as the first decade of life and causes average annual declines in eGFR of approximately fou (2022)

18 (1) ppubs.uspto.gov

... tissue sites where previously placed drug eluting constructs have failed. In another embodiment, medical devices as described herein can be used to establish, connect to, or maintain arteriovenous access sites, e.g., those used during kidney dialysis. Further examples of medical devices of the present invention which can be permanent or temporary are catheters. Examples of catheters include, but are not limited to, central venous catheters, peripheral intravenous catheters, haemodialysis catheters, catheters such as coated catheters include implantable venous catheters, tunnelled venous catheters, coronary catheters useful for angiography, angioplasty, or ultrasound procedures in the heart or in peripheral veins and arteries, hepatic artery infusion catheters, CVC (central venous catheters), peripheral intravenous catheters, peripherally inserted central venous catheters (PIC lines), flow-directed balloon-tipped pulmonary artery catheters, total parenteral nutrition catheters, chronic dwelling catheters (e.g., chronic dwelling gastrointestinal catheters and chronic dwelling genitourinary catheters), peritoneal dialysis catheters, CPB catheters (cardiopulmonary bypass), urinary catheters and microcatheters (e.g. for intracranial application). In one embodiment, the medical device is an expandable member which, according to the present invention, can b (2017)

19 (1) ppubs.uspto.gov

Vascular Valves And Servovalves - And Prosthetic Disorder Response Systems --- "Fiber-based Quantum-dot Pulse Oximetry for Wearable Health Monitoring with High Wavelength Selectivity and Photoplethysmogram Sensitivity," Online, Nature Partner Journals Flexible Electronics (Basingstoke, England) 7(1): 15).

20 (1) www.sec.gov

0.109 0.1160 0.105 0.108 0.050 0.750 0.025 0.650 P17Y1M6D P9Y2M12D P18Y1M6D P10Y2M12D P3Y2M12D P1Y6M P1Y6M P8Y8M12D P8Y1M6D 0.0046 0.0036 0.0153 0.0138 0.0151 0.0262 P5Y6M0D P6Y3M P6Y7D P6Y4M24D P6Y9 --- measures, patients may still experience acute hyperammonemia crises particularly in the setting of increased protein catabolism that can be induced by viral illness or certain medications. These acute crises are treated with supportive care including kidney dialysis for rapid ammonia reduction. The frequency and duration of hyperammonemia crises has been directly linked to poor long-term outcomes and intellectual disability. The only curative therapy available is liver transplantation, which has become more common as surgical techniques and supportive care have improved over time. In those patients with severe, neonatal onset of OTC deficiency, liver transplantation is commonly performed before the age of five and, in some cases, can occur before one year of age. In addition to the standard of care therapies noted above, therapies to replace the defective OTC gene have been pursued. Recent trials have primarily utilized AAVs to deliver a corrected OTC gene. While these viruses have to date been generally well tolerated, they are still associated with significant immunogenicity that can preclude use in the up to one third of patients with pre-existing antibodies to AAV and can lead to systemic symptoms, including elevated liver enzymes. Beyond the challenge of pre-existing antibodies, the primary drawback is the potential for transient efficacy as the gene replacement via AAV would not be expected to be permanent if replication of the target cell occurs. While the durability of an AAV delivered gene replacement for OTC deficiency depends on many factors, one of the key determinants is the rate of hepatocyte turnover. This is especially relevant in pediatric patients with growing livers and rapid cell turnover. This dilution of eff

21 (1) www.ejmcm.com
... decreased significantly. Theuse ofmitomycin-c for 30 seconds in myopic patients treated by PRK would affectcorneal endothelial cell density after three months postoperatively. Relationship Between Estimated Glomerular Filtration Rate With Plasma Lipid Levels In Non-Dialysis Diabetic Kidney Disease Patients Cely Palebangan; Haerani Rasyid; Andi Makbul Aman; Syakib Bakri; Husaini Umar; Andi Fachruddin Benyamin; Hasyim Kasim; Arifin Seweng European Journal of Molecular & Clinical Medicine, 2020, Volume 7, Issue 8, Pages 935-943 Aims: To assess the relationship between estim

23 (1) www.medindia.net
AWAK's 3kg wearable PD device, now in trials, aims to bring end-stage kidney patients the freedom to live their lives on their own terms. AWAK Technologies' wearable peritoneal dialysis (PD) device could allow kidney patients to perform dialysis on the go

24 (1) www.medindia.net
AWAK Technologies' wearable PD device enters trials, promising freedom and comfort for end-stage kidney patients. - https://www.medindia.net/news/healthwatch/awaks-portable-dialysis-device-offers-new-hope-for-kidney-patients-217860-1.htm Link: AWAK's Portable Dialysis Device Offers New Hope for Kidney Patients - https://www.medindia.net/news/healthwatch/awaks-portable-dialysis-device-offers-new-hope-for-kidney-patients-217860-1.htm

25 (1) www.medindia.net
What if kidney dialysis was portable? AWAK Technologies' wearable PD device enters trials, promising freedom and comfort for end-stage kidney patients.

27 (1) ksusentinel.com

Based on dialysis type , the wearable artificial kidney market is segmented into haemodialysis and peritoneal dialysis. (2021)

28 (1) www.mccourier.com

Based on dialysis type , the wearable artificial kidney market is segmented into haemodialysis and peritoneal dialysis. (2021)

31 (1) www.sec.gov

The Company's platform technology is a wearable artificial kidney for dialysis and other medical applications. This device treats the blood of patients through a pulsating, dual-chambered pump. Continuous dialysis has always been possible for patients who are able to make several weekly visits to a dialysis clinic to be attached to a large machine for three to four hours at a time. (2007)

33 (1) www.mccourier.com

Thus, the rising of campaign launches to increase awareness among patients to opt for ambulatory dialysis will further increase the demand for a wearable artificial kidney. (2021)

34 (1) www.biospace.com

SINGAPORE , Oct. 14, 2024 /PRNewswire/ -- Vivance, a leader in kidney care innovations, is proud to announce that the next trial phase of the wearable peritoneal dialysis (PD) device, Viva Kompact, has successfully concluded.

35 (1) pubmed.ncbi.nlm.nih.gov

Innovative dialysis technologies such as portable, wearable and implantable artificial kidney systems are being developed with the aim of addressing these issues and improving patient care.

36 (1) www.therecord.com

This artificial kidney is being developed as wearable technology. That is an international standard, so anyone on dialysis will be able to use the device from Qidni. (2017)

37 (1) glamsham.com

The report by GlobalData, a leading data and analytics company, focused on wearable medical devices for kidney disease and dialysis. It showed that wearable medical devices play a crucial role in enhancing the convenience and effectiveness of peritoneal dialysis (PD) a treatment for kidney failure that uses the lining of abdomen, or belly, to filter blood inside the body.

38 (1) exclusivepress.net
Peritoneal dialysis (PD) is a treatment for kidney failure that uses the lining of the patient's abdomen to filter blood inside the body.

39 (1) pubmed.ncbi.nlm.nih.gov
This study developed and tested a telemonitoring system using wearable sensors and a smartphone app to support chronic kidney disease patients on dialysis or during pre-dialysis care.

40 (1) www.businesswire.com
DUBLIN--(BUSINESS WIRE)--The "Global Wearable Artificial Kidney Market (2022-2027) by Dialysis Type, Disease, End-User, Geography, Competitive Analysis and the Impact of Covid-19 with Ansoff Analysis" report has been added to ResearchAndMarkets.com's offering. (2022)

42 (1) www.foxnews.com
Now they report the results of a 24-hour test of the wearable artificial kidney in 11 patients with end-stage kidney disease who had been on dialysis for an average of 15 months. (2022)

44 (1) menafn.com
India, the company is dedicated to the research, development and marketing of novel technologies in kidney care. MENAFN1410202400373200124lID1108776599 Caption: Vivance Completes Pre Pivotal Trial Of Wearable Dialysis Device Results To Be Shared At ASN Kidney Week

48 (1) www.thebrighterside.news
A new wearable dialysis device using ICP tech may transform kidney failure care and improve quality of life.

607 (1) www.newswise.com
Newswise - WASHINGTON, D.C., September 27, 2019 -- Patients with kidney failure often

require arteriovenous grafts to be connected to dialysis machines for their lifesaving treatment. However, one common problem with the artificial tubes is they can induce dangerous blood clotting. The complex interplay among the AVGs, the vessels they connect, and the blood they transport has been difficult to simulate with computers. One new method provides a way to model such relationships. Zengding Bai and Luoding Zhu from the Indiana University-Purdue University Indianapolis report their findings in Physics of Fluids, from AIP Publishing, on a series of simulations that reconstructed the fluid dynamics affected by the insertion of an AVG. (2022)

610 (1) pubmed.ncbi.nlm.nih.gov

Although preferred for most patients with chronic kidney disease (CKD), those undergoing dialysis continue to experience AVF surgical failures and complications, with 60% of AVFs failing to mature. The anastomotic angles chosen for AVF creation are usually ones that surgeons find easiest to manually control. At present, many sources have confirmed that variations in anastomotic angle culminate in differing geometric parameters of perianastomotic blood vessels, thus affecting the AVF maturation process. This publication was intended to highlight the progress achieved with respect to AVF anastomotic angle conventions through collective outcomes of clinical analyses, basic research, computational fluid dynamics (CFD) studies, and VasQ external stent trials.

621 (1) www.newswise.com

For people with kidney disease, dialysis can help the body perform these essential functions when the kidneys aren't working at full capacity. However, red blood cells sometimes rupture when blood is sent through faulty equipment that is supposed to clean the blood, such as a dialysis machine. This is called hemolysis. Hemolysis also can occur during blood work when blood is drawn too quickly through a needle, leading to defective laboratory samples. There is no reliable indicator that red blood cells are being damaged in a clinical setting until an individual begins showing symptoms, such as fever, weakness, dizziness or confusion. University of Delaware mechanical engineer Tyler Van Buren and collaborating colleagues at Princeton University have developed a method to monitor blood damage in real-time. "Our goal was to find a method that could detect red blood cell damage without the need for lab sample testing," said Van Buren, an assistant professor of mechanical engineering with expertise in fluid dynamics.

624 (1) www.technologyreview.com

As currently practiced, dialysis is a crude procedure. Patients are hooked up intravenously to a powerful pump that circulates their blood through a cartridge of porous plastic fibers. Fluids, dissolved toxins, and salts pass through the fibers and are discarded, while the proteins and blood cells caught in the sieve are supplemented with electrolyte before returning to the patient. The filter's poor fluid dynamics are a function of their imprecision: filter manufacturing produces a wide range of pores, so to avoid having too many large pores, which would suck out valuable proteins, the fibers must be manufactured with a preponderance of very small pores. The machine's pump makes up the difference, forcing blood through these inefficient sieves. In contrast, Fissell and Roy etch pores into ultrathin wafers of silicon with lithographic precision. The result is a homogenous array of pores, each capable of flow rates several orders of magnitude higher than the average pore in a conventional filter. The pores mimic the exquisitely precise yet efficient diaphragms that filter blood in a human kidney, resembling a panel of Venetian blinds, says Fissell. (2006)

626 (1) www.reading.ac.uk

Narrowed blood vessels (stenoses) are often seen in patients with kidney disease who need regular dialysis to clean their blood. This involves connecting one of their arteries to a vein, so the vein expands under pressure (known as a fistula) and can have a needle inserted to run blood through the dialysis machine. The narrowing is thought to be caused by high pressure and irregularities in blood flow through the vessels and the body attempting to heal damage from fast flowing blood. Up to 75% of fistulas end up needing surgery or stretching with a balloon to clear the blockage within the first year of treatment - at a cost to the NHS and adding to the discomfort and time in hospital for patients. A team led by RBH radiologist Farhan Ahmad and involving Dr Richard Harrison from the University's CINN Lab, created 3D models of the blood vessels in the arms of three healthy volunteers using ultrasound and Magnetic Resonance Imaging (MRI) to take image veins and arteries. The team wanted to test if ultrasound, which is far cheaper and more widely available than MRI, could be used to produce accurate 3D models of blood vessels to monitor blood flow in diabetes patients with fistulas. Working with Dr Yongmann Chung and computational modellers at the University of Warwick, the team applied dynamic fluid modelling to the images to simulate the flow of blood through the vessel.

648 (1) courtlistener.com

Sakharam D. Mahurkar, a physician, holds several patents on dual-lumen hemo-dialysis catheters. A dual-lumen catheter is a pair of tubes (lumens) designed to allow blood to be removed from an artery, processed in a machine that removes impurities, and returned close to the place of removal. Hemodialysis catheters are used to palliate kidney failure. In the event of chronic failure, physicians construct a fistula, a permanent internal connection between *519 vein and artery that provides ready, longterm access to the circulatory system. During the several weeks required for the fistula to mature and heal, physicians need another entry point, which the catheter provides. In the event of acute failure, immediate access is essential, again via catheter. Catheters cause trauma on insertion and while they remain. Every entry of a needle injures the blood vessel, the walls of which eventually collapse. The fewer entries, the better. The more comfort, the better. (Sometimes patients try to rip out catheters that aggravate them.) A catheter also should allow a high rate of flow without injury to the blood. Whirlpools, eddies, sharp edges, and collisions with rigid walls can rupture the red cells, which may lead to "hemolysis" (inability of the blood to carry sufficient oxygen) and to clotting. Either can cause brain damage or the death of the patient. Knowledge of fluid dynamics and the structure of the blood and vascular system is essential to design a catheter that can handle the necessary rate of flow at an acceptable rate of injury to the red cells. (1990)

664 (1) www.sec.gov

... is produced in bulk and is used principally as a whitener and opacifier for paper, plastics and paint. AHP uses a dense-phase crystal growth technique that controls crystal formation using a combination of mechanical, fluid dynamics, chemical and thermal control. We believe that costs associated with this process will be lower than costs associated with alternative processes. All hydrochloric acid waste streams can be recycled to recover acid, and the waste solids generated from the purification process are easily manageable iron oxides. In April 2007, we announ (2008)

666 (1) doi.org

The mass transfer behavior in a hollow fiber membrane module of membrane-based artificial organs (such as artificial liver or artificial kidney) were studied by numerical simulation. A new computational fluid dynamics (CFD) method coupled with K-K equation and the tortuous capillary pore diffusion model (TCPDM) was proposed for the simulations.

669 (1) www.scirp.org

M. Habib Sellami, "A Bio-Hydraulic Modelling Approach to Control the Hemodialysis Patient Status - Calculus and Validation," Open Journal of Fluid Dynamics, Vol. 3 No. 3, 2013, pp. 205-213. 2013.33026. H. J. Kemp, A. Pham and C. R. Tomson, "Urea Kinetic Modelling: A Measure of Dialysis Adequacy," Annals of Clinical Biochemistry, Vol. 38, 2001, pp. (2022)

674 (1) www.thefreelibrary.com

Using fluid dynamics to improve vascular access in haemodialysis. Renal Society of Australasia Journal, 11, 32-34. Brouwer, D.J. (2011). Cannulation Camp: Basic needle cannulation training for dialysis staff. (2022)

676 (1) clinicaltrials.gov

... long-lasting way to connect patient circulation to the artificial kidney. To date, VA dysfunction is the major cause of morbidity and hospitalisation in HD patients, and the major limitation of HD treatment. The current recommendation for VA is the native artero-venous fistula (AVF), surgically created in the forearm, but is still affected by high non-maturation and early failure rates. The most common cause of AVF early-failure is vascular stenosis due to neointimal hyperplasia (NH). Despite the exact mechanisms underlying stenosis development remain tentative, there is general consensus that hemodynamic conditions play a key role in the formation of NH. Previous computational fluid dynamics (CFD) investigations inside patient-specific AVF models conducted by our (2021)

683 (1) en.wikipedia.org

In computational fluid dynamics study, the ideal anastomotic angle should be less than 30 degrees to ensure laminar flow of the blood, thus prolong the endothelial cell survival, and prevent smooth muscle proliferation within vessel wall, and clogging the vessel. However, in another study using angiographic images of the juxta-anastomotic sites, the ideal anastomotic angle of less than 46.5 degrees was obtained. Surgically created AV fistulas work effectively because they: * Have high volume flow rate s (as blood takes the path of least resistance ; it prefers the (low resistance) AV fistula over traversing (high resistance) capillary beds). * Use native blood vessels, which, when compared to synthetic grafts, are less likely to develop stenoses and fail. ==History== The procedure was invented by doctors James Cimino and M. J. Brescia at the Bronx Veterans Administration Hospital in 1966. Before the Cimino fistula was invented, access was through a Scribner shunt , which consisted of a Teflon tube with a needle at each end. Between treatments, the needles were left in place and the tube allowed blood flow to reduce clotting. But Scribner shunts lasted only a few days to weeks. Frustrated by this limitation, James E. Cimino recalled his days as a phlebotomist (blood drawer) at New York City 's Bellevue Hospital in the 1950s when Korean War veteran s showed up with fistulas caused by trauma. Cimino recognized that these fistulas did not cause the patients harm and were easy places to get repeated blood samples. He convinced surgeon Kenneth Appell to create some in patients with chronic kidney failure and the result was a complete success.

699 (1) www.telegraph.co.uk

"It may be related to the fact that women have to give birth and are able to tolerate large changes in physiology and fluid dynamics," he said. "It may be that women are great at managing pregnancy but also at managing the stress of spaceflight on a physiological level. My wife asks me this all the time, actually. "We don't have the full answer yet as to why women seem to be a little bit more tolerant of the stressors of space flight but we're looking into it." The scientists say that overall the studies show that people are able to tolerate space travel, and that even members of the public can spend time in space safely. They added that medication will likely be able to protect and treat any issues that do emerge from being in space, particularly for long missions, such as any attempts to live on the Moon or visit Mars. Mars travellers 'might need dialysis' However, one study from UCL published in Nature Communications did find that space could have permanent and severe health implications for the kidneys. A combination of human data and animal experiments found that kidneys are physically reshaped by the space environment due to microgravity. Astronauts are prone to kidney stones, the study authors say, because kidney tubules can shrink in less than a month.

885 (1) doi.org

... rheoencephalography (REG) as a non-invasive method to measure changes in intracranial impedance during sleep. Sleep quality and its stages are closely linked to cerebral blood flow (CBF), cerebrospinal fluid (CSF) movement, and overall intracranial fluid dynamics. CBF naturally declines during sleep, a change associated with the glymphatic system, which plays a key role in clearing waste metabolites from the brain. This process is thought to be important in many neurological diseases, including Alzheimer's disease, where changes in CBF and CSF dynamics can occur before cognitive symptoms appear. Monitoring intracranial impedance flu

886 (1) financialpost.com

FloPatch is an FDA-cleared, wearable device that provides clinicians with a fast and non-invasive way to perform hemodynamic assessments, measuring a patients heart and blood flow response to IV fluids to help guide personalized fluid therapy. Clinical studies have shown that dynamic fluid assessments can reduce the need for mechanical ventilation and renal replacement therapy [3] ,, decrease ICU length of stay, and are associated with lower mortality.

887 (1) pubmed.ncbi.nlm.nih.gov

In this study, we used a digital coronary twin to establish a longitudinal hemodynamic map (LHM) of the rest and exercise states. An hour-long dataset for both the rest and exercise states, acquired from a wearable device for a single patient, was used to drive a complex 3D fluid dynamics simulation.

891 (1) pubmed.ncbi.nlm.nih.gov
This includes the impact that artificial intelligence can provide to develop computer-based clinical decision support system and that wearable sensors can offer to remotely monitor high-risk bicuspid aortic valve (BAV) patients. First, we discussed the benefit of computational modeling by providing tangible examples of in-silico software products based on computational fluid-dynamic (CFD) and finite-element method (FEM) that are currently transforming the way we diagnose and treat cardiovascular diseases. Then, we presented recent findings on computational hemodynamic and structural mechanics of BAV to highlight the potentiality of patient-specific metrics (not-based on aortic size) to support the clinical-decision making process of BAV-associated aneurysms. (2019)

894 (1) doi.org
Therefore, besides intermittent systolic and diastolic BP (SBP and DBP) measurements, cuffless BP estimation is expected to be applied for: (1) continuous and long-term BP monitoring, tracking BP patterns and BP variability (BPV) for early diagnosis of BP disorders (e.g., hypertension and hypotension) and cardiovascular diseases (CVD); (2) nocturnal BP measurement which is hard to measure by conventional devices; (3) long-term BP management follow-up (e.g., the effect of anti-hypertension medication); (4) incorporating with other wearable sensors (e.g., body temperature, acceleration, respiration) for detailed hemodynamic and overall health assessment. There have been several different technologies applied for cuffless BP estimation5 . For example, a non-contact BP estimation method was developed by processing facial video and extracting pulse waveform features using a smartphone6 . The ultrasound sensor was applied to measure the cross-sectional area and blood velocity of the carotid artery and compute pulse pressure based on fluid dynamic principles7,8 .

895 (1) doi.org
The pulsatile 3D-printed simulation platform and the computational fluid dynamics can accurately replicate the human hemodynamic environment . Integrating these methods provides a realistic in vitro platform for testing and developing devices, enabling precise simulation of cardiac tissue stress, deformation, and blood flow dynamics . With ongoing technological advancements and decreasing costs, the adoption of 3D printing and computational fluid dynamics is expected to enhance the development of TAVR technology and the management of QAV. Lastly, a well-established postoperative follow-up strategy is crucial for TAVR-treated patients with QAV due to the lack of strong evidence for these off-label indications. At our center, we have successfully implemented the hospital - community - home closed-loop management model. In addition to standardized follow-up staff to ensure patients' timely postoperative assessment, we recommend home-appropriate smart wearable

devices for selected patients.

901 (1) doi.org

Continuous Blood Pressure Estimation From Electrocardiogram and Photoplethysmogram During Arrhythmias" proposed a machine learning-based approach for cuff-less and continuous BP estimation using electrocardiogram (ECG) and PPG in episodes of ventricular and supraventricular arrhythmias. Hemodynamic parameter estimation is further challenged in arrhythmia periods due to associated morphological variations of the cardiac cycle. Several indices have been derived from the PPG and used as predictive markers of different health outcomes. The review "Risk factors and predictive indicators of rupture in cerebral aneurysms" by Wang and Huang highlighted how the advancement in computational fluid dynamics and machine learning can facilitate the creation of new predictive models for assessing rupture risk in cerebral aneurysms. This is particularly important because the structural response of the aneurysmal wall to hemodynamical factors plays a crucial role in aneurysm stability and risk for rupture. The authors discuss hemody

905 (1) www.thefreelibrary.com

The Computational Fluid Dynamics Analyses on Hemodynamic Characteristics in Stenosed Arterial Models. Zhou, Yue; Lee, Chunhian; Wang, Jingying 3061 The Effect of Augmented Reality and Virtual Reality on Inducing Anxiety for Exposure Therapy: A Comparison Using Heart Rate Variability. Tsai, Chai-Fen; Yeh, Shih-Ching; Huang, Yanyan; Wu, Zhengyu; Cui, Jianjun; Zheng, Lirong 5822 The Effect of Kinesiology Taping on the Hemiplegic Shoulder Pain: A Randomized Controlled Trial. Yang, Lin; Yang, Jingyi; He, Chengqi 5273 The Effect of Optical Crosstalk on Accuracy of Reflectance-Type Pulse Oximeter for Mobile Healthcare. Baek, Hyun Jae; Shin, JaeWook; Cho, Jaegeol 4246 The Evolving Role of Information Technology in Haemovigilance Systems. Ramoa, Augusto; Condeco, Jorge; Escoval, Maria Antonia; Faber, Jean-Claude; Fdez-Riverola, Florentin 4885 The Influence of Accreditation on the Sustainability of Organizations with the Brazilian Accreditation Methodology. Correa, Joao Ederson; Turrioni, Joao Batista; de Paiva, Anderson Paulo; Paes, Vinicius de Carvalho; 7777 The Patient in Precision Medicine: A Systematic Review Examining Evaluations of Patient-Facing Materials. Wynn, Rachel M.; Adams, Katharine T.; Kowalski, Rebecca L.; Shivega, Winnie G.; Ratwani, Raj M.; Mil 6767 The Wall Apposition Evaluation for a Mechanical Embolus Retrieval Device. Gu, Xuelian; Qi, Yongxiang; Erdman, Arthur G. 3788 Towards Optimal Platform-Based Robot Design for Ankle Rehabilitation: The State of the Art and Future Prospects. Miao, Qing; Zhang, Mingming; Wang, Congzhe; Li, Hongsheng Report 6242 Unsupervised Medical Entity Recognition and Linking in Chinese Online Medical Text. Xu, Jing; Gan, Liang; Cheng, Mian; Wu, Quanyuan 8571 Vision Diagnostics and Treatment System for Children with Disabilities. Kasprowski, Pawel; Harezlak, Katarzyna 6086 Wearable Sensors for Measuring Movement in

Short Sessions of Mindfulness Sitting Meditation: A Pilot Study. (2018)

906 (1) www.degruyter.com
... and MPS Progress and challenges in the development of novel implant concepts for cardiovascular, ophthalmologic and otolaryngologic applications Electrospinning for polymeric implants in cardiovascular applications Optimization of stent designs regarding the thrombosis risk using computational fluid dynamics Heart phantom with electrical properties of heart muscle tissue Effects of local activation times on the tension development of human cardiomyocytes in a computational model Regional analysis of airway abnormalities in cystic fibrosis employing Electrical Impedance Tomography Short Distance Impedance Pneumography Bioimpedance Analysis of L929 and HaCaT Cells in Low Frequency Range Context-aware medical technologies - relief or burden for clinical users? The opportunities of biodynamic lighting in homes for the elderly AAL Functions for Home Care and Security Silicone-based Chip-in-Foil System Biomechanics and clinical experience of a 3D biomimicking vascular stent Novel 3D printing concept for the fabrication of time-controlled drug delivery systems Histological evaluation of a cochlear implant electrode array with electrically activated shape change for perimodiolar positioning Hemodynamic influence of design parameters of novel venous valve prostheses Development and validation of a tissue-equivalent test environment for detection of malfunctions in active medical implants caused by ionizing radiation Usability Evaluation of a One-Handed Touchbased OR-Table Control Postural workloads on paramedics during patient transport

907 (1) www.newsbreak.com
... of the disease and aid in the clinical decision-making process. In this work, a patient-specific geometry of type-B AD is reconstructed from computed tomography images, and a numerical simulation using personalised computational fluid dynamics (CFD) with three-element Windkessel model boundary condition at each outlet is implemented. According to the physiological response of beta-blockers to the reduction of left ventricular contractions, three case studies with different heart rates are created. Several hemodynamic features, including time-averaged wall shear stress (TAWSS), highly oscillatory, low magnitude shear (HOLMES), and flow pattern are investigated and compared between each case. Results show that decreasing TAWSS, which is caused by the reduction of the velocity gradient, prevents vessel wall at entry tear from rupture. Additionally, with the increase in HOLMES value at distal false lumen, calcification and plaque formation in the moderate and regular-heart rate cases are successfully controlled. This w (2021)

909 (1) doi.org

With wearable ultrasound technology, tracking these hemodynamic measures in real time, and in response to provocative maneuvers, is of tremendous utility to intensivists . Clinical implications A recently published framework speculates how simultaneously acquired venous and arterial Doppler ultrasound could inform patient therapy and posits that Doppler ultrasound accompany all advanced critical care echocardiography to better delineate unique hemodynamic phenotypes . For instance, dynamic fluid intolerance describes a hypo-perfused patient subtype with suggestive signs of low filling pressure (e.g., flat jugular vein, collapsing inferior vena cava, low central venous pressure) who is, nevertheless, found to be fluid unresponsive during a dynamic maneuver such as a PLR . (2022)

911 (1) doi.org

Herein, we report a wearable thermal analysis system in a thin, soft, and flexible format, named as a wearable hemodynamic sensor (WH-sensor), that allows for the hemodynamic status of specific blood vessels to be monitored effectively and conveniently in a wearable and non-invasive way. A high-density sensing array associates with 80 thermal sensing units based on negative temperature coefficient (NTC) thermistors with remarkable sensitivity, serving as the key components for thermal analysis, which integrates on a soft substrate to segment the detecting region. The data transmitted from sensing channels are operated through multiplexers, electrical components increasing the number of channels. As the surface-mount device (SMD) type of thermistors with a size of 1.0 mm 0.5 mm (length width) are adopted, the resolution of the monitoring system is improved while the extent of the device is maintained tight. Furthermore, for real-time monitoring, a graphical user interface (GUI) is implemented wirelessly via Bluetooth modules on the screen of external electronic devices such as a computer and smartphone. Through this GUI software, the blood vessel and hemodynamic status can be detected and evaluated in colors on the GUI indicating the level of heat according to the sensed temperature. The equipment that is directly attached to a skin senses a greater heat for the region where a blood vessel is. Even on the condition that there is a blockage due to the presence of thrombus and cholesterol on the wall of the vessel, a reduced diameter of the blood pathway would induce noticeably less heat because of a decrease in the volumetric flow rate of the blood according to the fluid dynamic principle . (2021)

914 (1) doi.org

CCTA . High risk coronary atheromatous plaque features and coronary micro-calcification and inflammation on CCTA can be more accurately identified by radiomic based ML platforms than the visual interpretation by the clinician . Hemodynamic assessment of a coronary lesion is done by the invasive fractional flow reserve (FFR) on cardiac catheterization or noninvasively by estimating myocardial flow reserve on 13 N-Ammonia positron emission tomography (PET) . In contrast to FFR and PET, ML-derived algorithms accurately detected hemodynamically significant obstructive coronary lesions and are comparable with a complex computation fluid dynamic modelling method to detect obstructive lesions . AI-enabled CT scan can be used to detect myocardial scarring due to myocarditis and myocardial infarction accurately and left ventricular dilation and systolic function in patients with ventricular tachycardia . Deep learning algorithms have enabled cardiac magnetic resonance imaging (CMR) (2022)

917 (1) www.houstonmethodist.org

... for cardiovascular disease Boada, C, Sukhovershin, R, Pettigrew, R & Cooke, JP 2021, , Current Opinion in Cardiology, vol. 36, no. 3, pp. 256-263. https://doi.org/10.1097/HCO.0000000000000850 Impact of malapposed and overlapping stents on hemodynamics: A 2d parametric computational fluid dynamics study Lagache, M, Coppel, R, Finet, G, Derimay, F, Pettigrew, RI, Ohayon, J & Malve, M 2021, , Mathematics, vol. 9, no. 8, 795. https://doi.org/10.3390/math9080795 The Limitless Future of RNA Therapeutics Damase, TR, Sukhovershin, R, Boada, C, Taraballi, F, Pettigrew, RI & Cooke, JP 2021, , Frontiers in Bioengineering and Biotechnology, vol. 9, 628137. https://doi.org/

918 (1) www.uclahealth.org

... oxide production via S-glutathionylation of eNOS. Biochemical and Biophysical Research Communication. 2013 Jul 5;436(3):462-6. Yu Zhao, Fei Yu, Hung Cao, Honglong Chang, Xiaoxiao Zhang, Tzung K. Hsiai*, Yu-chong Tai. A Wearable Percutaneous Implant for Long-Term Zebrafish Epicardial ECG Recording. Transducers 2013. Juhyun Lee, Mahdi Esmaily-Moghadam, Ethan Kung, Hung Cao, Tyler Beebe, Longhou Fang, Yuri Miller, Ching-Ling Lien, Neil C. Chi, Alison L. Marsden, and Tzung K. Hsiai*. Moving Domain Computational Fluid Dynamics to Interface with An Embryonic Zebrafish Model of Cardiac Morphogenesis. Fei Yu, Wakako Takabe, Michael Harrison, Nelson Jen, Taylor Bebee, Juhyun Lee, Hung Cao, Peidong Han, Ching-Ling Lien, Rongsong Li, Neil C. Chi, Tzung K. Hsiai*. Shear Stress-Activated Wnt-Angiopoeitin-2 Signaling Recapitula

920 (1) doi.org

Kubicek et al. have proposed a non-invasive measurement technique to measure the cardiac hemodynamic parameters using the impedance cardiography (ICG) method . High-frequency current signals are input through the surface electrodes to detect changes in the capacitive impedance of the thoracic cavity caused by heart beats in order to assess the SV . In recent years, cardiac fluid dynamics parameter monitoring research using the ICG technology has been applied in the anesthesia monitoring , the pediatric intensive care unit monitoring , and the status assessment of increase in exercise load . (2018)

922 (1) doi.org

The goals for the device are to provide high flow (3.5 L/min) with a low priming volume (9.5 mL) and, when coupled with the Universal MagLev System, a small, compact form factor with the potential to be battery-powered and wearable. This article also outlines the criteria used to define the design input requirements for the Inspired Pediatric VAD (flows and pressures), details the methods and processes used to design two versions of the pump impeller and housing (Pump V1 and an improved version, Pump V2), and describes the methods used to confirm both designs using computational fluid dynamics (CFD) simulations. (2021)

926 (1) patents.google.com

The method of claim 1, wherein the computational model further comprises numerical simulation comprising computational fluid dynamics, fluid structure interaction models. 3. The method of claim 1, wherein the computational model further comprises a trained artificial intelligence neural network to determine a likelihood of thrombosis based on the fraction of circulation influx into the neo-sinus area based on the one or more anatomical and flow parameters. 4. The method of claim 1, wherein the computational model further comprises a machine learning algorithm to obtain the one or more anatomical parameters and the one or more flow parameters. 5. A computer implemented method to evaluate a risk of development of thrombosis for a patient planning on receiving a heart valve implantation, the method comprising: executing, by at least a processor, program code stored in a non-transitory computer-readable-medium to perform a simulation, comprising: gathering image data representing one or more anatomical and hemodynamic parameters of a region of a heart of the patient prior to receiving the heart valve implantation, wherein the image data comprises three-dimensional shapes of the region of the patient's heart;

927 (1) doi.org

When integrated with continuous technologies such as bioreactance or pulse contour analysis, it allows for the adoption of more dynamic and personalized fluid management strategies. Currently, a multimodal and patient-centered approach represents the most effective paradigm for non-invasive hemodynamic evaluation in the emergency setting.

932 (1) doi.org

Although CTA enables visual evaluation of a stenotic lesion, it lags behind invasive FFR for assessing the hemodynamic significance of coronary stenosis. Coronary fractional flow reserve (CT-FFR) has become a suitable non-invasive modality for evaluating ischemic heart disease and chest pain. Furthermore, it can perform this task without the requirement of additional medications or imaging. It provides functional and anatomic evaluation, this approach is steadily gaining momentum in CT imaging. ML algorithms can calculate FFR in the absence of computational fluid dynamics and yield additional prognostic information. (2021)

935 (1) meta-guide.com

Meshes are the input for computational fluid dynamics (CFD) analysis, whose size and quality have important impact on the simulation results. With the cont. Extended Reality Environments XML3D content may be presented in web browsers supporting WebGL, without installing additional plug ... It permits further application of arbitrary 3D models of avatars, which thereby get animated ... 2.2, tracking a skeleton and applying an avatar in the Organic Motion OpenStage ... Sign Language Generation System Based on Indian Sign Language Grammar P Kumar, S Kaur - ACM Transactions on Asian and Low-Resource ..., It has the corpus of 2,950 words and 1,000 sentences. There are many filters provided by the system that the administrator can easily use to search a specific word in the corpus. The system uses WebGL for fast 3D avatar animation and makes it compatible with all browsers ... Engineering a Virtual Lab for the Sports Sciences Using Wearables and IoT

939 (1) clinicaltrials.gov

Impact on digital biomarkers (neuro-fluid dynamics (hemodynamics, CSF) and redox state of cytochrome-c-oxidase activity using fNIRS) 2. Effect on plasma biomarkers associated with neurodegeneration, inflammation and neural plasticity - GFAP, NfL and S100B and BDNF 3. Cognitive (spatial memory) and functional outcomes 4. Sleep patterns and quality through wearable devices and questionnaires

943 (1) www.frontiersin.org

Here, neuronal and hemodynamic responses measured with EEG-NIRS neuroimaging can be represented abstractly as the system response of the NVU to tDCS perturbation (see Figure 1) where presence of symmetry in the nonlinear network of NVU (see Figure 1) may decrease observability (Whalen et al., 2015). Since no real-world network has exact symmetries so with intelligent placement of EEG-NIRS sensors (e.g., to avoid systemic interference; Sood et al., 2015) along with system identification and parameter estimation techniques, it may be possible to track the spatiotemporal change of the states of the NVU. This observer model can then be used to drive multi-electrode tDCS (Dmochowski et al., 2011) for active spatiotemporal modulation of the brain states (e.g., posterior alpha-rhythm). Here, we base our discussions on the recent advances in Kalman filtering approaches to spatiotemporal nonlinear systems (Schiff and Sauer, 2008) and an understanding from group representation theory in controller or observer design by obtaining a modal decomposition into decoupled controllable and uncontrollable (observable and unobservable) subspaces (Whalen et al., 2015). Specifically, Schiff and Sauer (2008) showed the feasibility of unscented Kalman filter (UKF) for recursive estimation of system state for nonlinear systems, including unobserved variables and parameter tracking, in a spatiotemporal model of cortex where such a nonlinear system is controllable using an adaptive feedback electrical field. Here, discretization of the whole-brain detailed biophysical model of NVU (Jolivet et al., 2015), for example with Galerkin methods that are used quite robustly in fluid dynamics, will be necessary where each discrete element corresponds to a volume of tissue imaged as well as stimulated with the EEG-NIRS/tDCS unit (see Figure 1).

944 (1) doi.org

According to traditional hemodynamic theory, an increase in afterload is indicated by prolongation of isovolumic contraction time (IVCT) and shortening of ejection time, suggesting impaired left ventricular function . For instance, in patients with ordinary hypertension, elevated peripheral vascular resistance leads to a significant shortening of LVET, which is closely related to a decline in myocardial contractile efficiency. However, this study found that patients with PE exhibited the opposite phenomenon of prolonged LVET (320 26.79 ms vs. 301 35.42 ms, p = 0.010), which contradicts the previous findings and suggests that its pathological mechanism is pregnancy - specific, possibly involving a unique interaction between the placenta and the heart axis . The unique physiological changes during pregnancy provide a structural basis for the prolongation of LVET. In normal pregnancy, a 40% - 50% increase in blood volume leads to a significant increase in preload, which enhances myocardial contractility through the Frank - Starling mechanism . Systemic vasodilation begins in the 5th week of pregnancy and reaches its lowest point in the second trimester, reducing vascular resistance and accommodating the surge in blood volume. In this study, the mild increase in LVEF in the PE group (64.8 3.5% vs. 62.8 2.6%) may be partially attributed to this mechanism. Although afterload increases in PE, blood volume expansion maintains a higher ventricular filling pressure, allowing the left ventricle to maintain a longer effective working time during the ejection period. Computational fluid dynamics models show that geometric remodeling of the ventricle during pregnancy (such as chamber enlargement and ventricular wall thickening) can prolong LVET by approximately 8 - 12 ms under the same afterload, providing a biomechanical basis for explaining the changes in LVET in PE .

945 (1) www.elsevier.com

Computational fluid dynamics for biocompatibility analysis Right impeller design changes

Total artificial heart for pediatric use Total artificial heart for very small patients Biventricular heart failure support using a dual centrifugal pump Cardiac Transplantation and Organ Preservation Which solution to preserve the heart? Blood or crystalloid? Which carrier for oxygen? Ischemic or nonischemic? How to assess organ preservation? Hurdles and challenges of prolonged cardiac perfusion From cardiac preservation to organ banks Extracorporeal Membrane Oxygenation in Adults Venovenous extracorporeal membrane oxygenation for respiratory failure Venoarterial extracorporeal membrane oxygenation for cardiac failure Device-Based Circulatory Support Therapy for Heart Failure with Preserved Ejection Fraction Interatrial shunt device LV expander Electrical therapy for HFpEF Left ventricular assist devices for diastolic dysfunction Devices in development (preclinical) Part IV: Innovative Surgical Approaches and Interventional Techniques Cardiac Implantable Devices in Heart Failure: Role of Imaging LV remodeling devices Short-term assist devices IABP devices ECMO devices Impella devices Long-term circulatory support devices Imaging in patients with VAD Imaging Technologies and Virtual Planning for Congenital Heart Repairs Cross-sectional imaging overview Role of cardiac computed tomography Role of cardiac magnetic resonance Imaging segmentation CCT versus CMR for segmentation Image rendering: surface versus volume Hemodynamic simulation

947 (1) ppubs.uspto.gov

As a type of phase transition, they share features with non-biological, non-equilibrium phase transitions such as the onset of lasing in a laser or the abrupt change from laminar to turbulent flow in fluid dynamics. Such phase transitions are described by non-linear dynamical equations that exhibit generic properties immediately before the change of phase occurs [Scheffer M, Bascompte J, Brock W A, Brovkin V, Carpenter S R, Dakos V, Held H, van Nes E H, Rietkerk M, Sugihara G. Early-warning signals for critical transitions. (2012)

948 (1) ppubs.uspto.gov

As a type of phase transition, they share features with non-biological, non-equilibrium phase transitions such as the onset of lasing in a laser or the abrupt change from laminar to turbulent flow in fluid dynamics. Such phase transitions are described by non-linear dynamical equations that exhibit generic properties immediately before the change of phase occurs [Scheffer M, Bascompte J, Brock W A, Brovkin V, Carpenter S R, Dakos V, Held H, van Nes E H, Rietkerk M, Sugihara G. Early-warning signals for critical transitions. (2012)

949 (1) www.jove.com

Influence of Distal Re-entry Tears on False Lumen Thrombosis After Thoracic Endovascular Aortic Repair in Type B Aortic Dissection Patients: A Computational Fluid Dynamics Simulation

Cardiovascular Engineering and Technology. Pubmed ID: 33768445 Surface Modification of Electrospun Fibers with Mechano-growth Factor for Mitigating the Foreign-body Reaction Bioactive Materials. Pubmed ID: 33732968 Effect of the Medial Collateral Ligament and the Lateral Ulnar Collateral Ligament Injury on Elbow Stability: a Finite Element Analysis Pubmed ID: 33715549 Biochemical and Morphological Abnormalities of Subchondral Bone and Their Association with Cartilage Degeneration in Spontaneous Osteoarthritis Pubmed ID: 33715052 Microcracks on the Rat Root Surface Induced by Orthodontic Force, Crack Extension Simulation, and Proteomics Study Annals of Biomedical Engineering. Pubmed ID: 33686616 Erratum to "Analysis of Bone Mineral Density/Content of Paratroopers and Hoopsters" Pubmed ID: 33680416 Nanopharmaceutical-based Regenerative Medicine: a Promising Therapeutic Strategy for Spinal Cord Injury B. 03, 2021 | Pubmed ID: 33662083 Direct Mapping from Diffuse Reflectance to Chromophore Concentrations in Multi- Spatial Frequency Domain Imaging (SFDI) with a Deep Residual Network (DRN) Biomedical Optics Express. Pubmed ID: 33659081 Stimulation of Vascular Smooth Muscle Cell Proliferation by Stiff Matrix Via the IK Channel-dependent Ca Signaling Pubmed ID: 33650160 Influence of Renal Artery Stenosis Morphology on Hemodynamics Pubmed ID: 33565336 Effects of Reverse Deployment of Cone-shaped Vena Cava Filter on Improvements in Hemodynamic Performance in Vena Cava

950 (1) doi.org

... will discuss the four commonly used fluid responsiveness dynamic parameters for GDFT guidance: pulse pressure variation (PPV), pleth variability index (PVi), stroke volume variation (SVV), and aortic blood flow peak velocity variation (ΔVpeak). Figure 3 shows the dynamic parameter equations, which are crucial to understand how to interpret each parameter accurately, and for providers to judge the appropriateness to use each parameter in different physiological states or surgeries. For example, PVi may not be accurate in low perfusion states due to its use of perfusion index. Pulse Pressure Variation (PPV) in Goal-Directed Fluid Therapy PPV is a fluid responsiveness dynamic parameter described by Coyle et al. in 1983 . PPV is calculated by measuring PP alterations during the respiratory cycle (Figure 2b) . In general, patients with a PPV <12% are unlikely to benefit from further fluid therapy, whereas those with >12% are more likely to benefit from fluid resuscitation . Compared to CVP, which requires a central venous catheter, PPV requires a minimally invasive or noninvasive monitor, commonly an arterial catheter. It is important to note that PPV does not indicate a patient's fluid status or preload; rather, it is only an indicator of the patient's position on the Frank-Starling curve . PPV has been used to guide GDFT. For example, Malbouisson et al. showed that PPV-guided GDFT reduced postoperative complications such as respiratory, renal, and hepatic dysfunctions, and hospital length of stay, in high-risk patients undergoing open surgeries . However, there have been small RCTs with negative clinical results on PPV-guided GDFT. For instance, Suzuki et al. found that PPV-guided GDFT did not significantly affect renal, hemodynamic,

951 (1) www.newswire.com

These Nano-engineered functional devices provide continual monitoring and authentication, while providing additional data points on well-being, level of awareness, and direct access to various biometrics such as heart rate, lung function and fluid dynamics to name a few.

958 (1) ppubs.uspto.gov

... a heart rate sensor to track cardiovascular responses affecting cerebrospinal fluid dynamics; and

959 (1) www.koreanewswire.co.kr

PVi is indicated as a noninvasive, dynamic indicator of fluid responsiveness in select populations of mechanically ventilated adult patients.

963 (1) ppubs.uspto.gov

We also envision this similar technology can be applied to automate dialysis toward a wearable application.

964 (1) patents.google.com

In apparatuses for renal care purpose (hemodialysis for chronic renal care or acute renal failure treatments, or during extracorporeal plasma processing e.g., hemodialysis, hemofiltration, hemodiafiltration, plasmapheresis etc.) the hemodynamic parameters of the patient are measured indirectly through the blood lines (e.g.: arterial and venous average pressures with semi-invasive sensors part of the blood line itself) or sporadically with a traditional inflatable cuff which is arranged on the patient arm. Using of a traditional inflatable cuff does not allow for a continuous blood pressure reading, since its operation involves a temporary occlusion of the arteries and veins of the patient's arm. Moreover, measurement is quite uncomfortable and may be painful for the patient making not acceptable to repeat the measure continuously during a dialysis treatment.

968 (1) doi.org

A wearable device with two modules, one for the BCG acquisition and one for the SCG acquisition, was used. (2021)

1051 (1) doi.org

... conducted without any active participation by the patient. Since monitoring of LVAD patients is complex and sensitive, it would be necessary to have continuous access to LVAD controller parameters (alarms, rotation speed, energy consumption, flow, pulsatility index), BP, blood coagulation values and concomitant drug treatment. One of the most feared complications of LVAD treatment, especially in the long-term, is transmission infection. This makes prevention particularly important. An algorithm based on image pixelation transmitted by the smartphone of the driveline exit site to the hospital is currently under development to promptly detect inflammation around the site of transmission. The Chronicle Off (2020)

1052 (1) www.uclahealth.org

Li, Nelson Jin, David Ann, Tzung Hsiai*. Atherogenic Shear Stress Promotes Both Mitochondrial DNA Damage and Autophage to Maintain Endothelial Homeostasis (in preparation) Nelson Jin, Rongsong Li, Mohamed Handam, Tzung Hsiai*. Tachyarrhythmia-Induced Increased in Pulsatility Reduces Shear Stress and Promotes Mitochondrial Redox State and Autophage (in preparation) Hung Cao, Yu Zhao, Juhyun Lee, Fei Yu, Yu Chong Tai, Ellen Lien, Tzung Hsiai*. Wireless MicroECG Recording of Neonatal Mouse Model of Heart Regeneration (in preparation) http://h

1053 (1) doi.org

... drug screening with the aim of reducing the intervention time and to set up more efficient therapies. Thanks to their conduit-like design, and to their precise control over flow conditions, including shear stress and pulsatility, microfluidic devices are particularly likely to be used as reductionist models of cardiovascular biology (e.g., to mimic blood flow and predict injuries to blood vessels), than to study heart-related issues. Nevertheless, modern biomedical engineering is advanced enough as to reproduce cardiovascular system complexity. Microfluidic cardiac cell cultures are physiologically relevant in vitro models that recreate mechanical loading conditions seen in both normal and pathological conditions and (2015)

1054 (1) www.ellibs.com

Sensor and Inductive Thorax-Plethysmography J. Muehlsteff, R. Pinter, G. Morren Interactive Knowledge-Based Anaesthetic Drug Infusion Systems Helmut Schwilden, Jurgen Schuttler Physiological Control of a Rotary Left Ventricular Assist Device: Robust Control of Pressure Pulsatility with Suction Prevention and Suppression A. Arndt, P. Nusser, B. P. Lampe, J. Muller A Transfer Function Method for the Assessment of Oxygen Uptake Dynamics during Walking by Use of a Triaxial Accelerometer K. Niizeki, Y. Takahashi, T. Saitoh, I Nishidate, K. Uchida

Heart Rate Spectrum Analysis for the automated Classification of Sleep (2009)

1055 (1) doi.org

In healthy conditions, there exists an optimal hemodynamic balance between the LV, the arterial network (aorta and its vascular branches), and the LA that guarantees delivery of the cardiac output with minimal energy expenditure and modest pulsatility in flow and pressure . Optimal atrioventricular-aortic hemodynamic coupling can be impaired due to age-related or disease-related changes. For example, recent clinical studies have shown that stiffening of the proximal aorta is associated with pulsatile load on the heart and can lead to the development of heart failure [3,6,11,12]. While the physiological importance of such optimal hemodynamic balance between the LV, the LA, and the vascular network has been shown extensively [2,3,7,13 - 15], the effects of the individual contributions from ventricular, atrial, and arterial parameters towards generating pressure and flow waves remain unexplored. In order to study the isolated effects of such parameters, it is essential to keep other parameters of the circulation either constant or under control. In-vitro fluid dynamics studies of cardiovascular systems have shown to be effective in understanding the underlying hemodynamics mechanisms of diseases [4,16 - 21]. (2022)

1056 (1) doi.org

The HF-AC component primarily signifies arterial pulsatility and constitutes the foundation of the PPG signal .Fig. 3 Flexible and wearable PPG sensors (a) working principle of PPG sensor.

1057 (1) doi.org

The effect of CSVD further extends to the glymphatic system or vice versa; pathology in small vessels disrupts perivascular fluid dynamics, which plays a critical role in waste clearance. For the glymphatic system, an intact vascular network is required, along with sufficient arterial pulsatility, to drive onward the movement of CSF through the perivascular spaces.

1058 (1) worldwide.espacenet.com

WO 2013/030744 A1 discloses a wearable pulse oximetry device that is mounted on a wrist strap and fixates an area above a distal end of the ulna with a dome-shaped structure. This area is used as the measuring area. The measurement is carried out by a detector positioned above the fixated area that detects light emitted by light sources having different wavelengths that are located at a periphery of the fixated area. Hence, the reflections are measured at neither a reflection mode nor a transmission mode, but are at an angle between 20°and 160°from the emitted light. This mode, termed trans-illumination, shall allow achieving an excellent signal-to-noise ratio and shall enable continuous and reliable measurement of oximetry data on the wrist. It is further describes that coherent light scattering (CLS) can be used for coping with motion artifacts. If a PPG signal is low, two scenarios are possible: i) The patient is centralized or suffers from vascular stiffness. The blood vessels are relatively stiff (high arteriolar and venular tone resulting in high vascular resistance) and the response to the blood volume variation in a cardiac cycle is also low. This has to do with the inability of the blood vessels walls to respond to the heartbeat induced pulsatile pressure/flow variation. Hence, the vascular compliance, i.e., the ability to dilate upon arrival of a blood pressure pulse, is low. ii) There is low cardiac output. In this case the weakness of the PPG signal is caused by lower blood volume in a heartbeat. PPG monitoring for peripheral perfusion can thus not distinguish between low pulsatility caused by low vascular compliance (due to centralization and/or vascular stiffness) or caused by low cardiac output.

1059 (1) www.frontiersin.org

Background: Intracranial photoplethysmography (PPG) signals can be measured from extracranial sites using wearable sensors and may enable long-term non-invasive monitoring of intracranial pressure (ICP). However, it is still unknown if ICP changes can lead to waveform changes in intracranial PPG signals. Aim: To investigate the effect of ICP changes on the waveform of intracranial PPG signals of different cerebral perfusion territories. Methods: Based on lump-parameter Windkessel models, we developed a computational model consisting three interactive parts: cardiocerebral artery network, ICP model, and PPG model. We simulated ICP and PPG signals of three perfusion territories [anterior, middle, and posterior cerebral arteries (ACA, MCA, and PCA), all left side] in three ages (20, 40, and 60 years) and four intracranial capacitance conditions (normal, 20% decrease, 50% decrease, and 75% decrease). We calculated following PPG waveform features: maximum, minimum, mean, amplitude, min-to-max time, pulsatility index (PI), resistive index (RI), and max-to-mean ratio (MMR).

1060 (1) doi.org

The earliest ideas, like the Virchow-Robin perivascular spaces, and Cushing's fluid-dynamics ideas, hinted at specialized clearance routes, while diffusion models of solute transfer predominated for most of the twentieth century . These models could never explain the rapid clearance of macromolecules observed in tracer studies, especially for peptides like amyloid-β and tau . With the discovery of the glymphatic system in 2012, the problem was shifted to a perivascular convective pathway driven by influx of cerebrospinal fluid (CSF) into periarterial spaces and efflux in perivenous paths, through aquaporin-4 (AQP4) channels on astrocytic endfeet . Nonetheless, despite the adoption of such concepts, several issues remained. How are these flows initiated and sustained, and where exactly are they exiting the intracranial compartment? Over the last 2 years, a number of original studies have refined these questions and begun to arrive at mechanistic answers. Multiple lines of evidence now suggest that the glymphatic system must be reconciled with venous hemodynamics and meningeal lymphatics . This integrative systems approach, which we will thus refer to in the following as the glymphatic-venous axis, relates state-dependent oscillations of arterial and brain tissue dynamics to venous outflow and meningeal lymphatic drainage. What separates this axis from others is that it is a convergence clearance pathway: not just a linear sequential pathway, but a biomechanically coupled pathway in which failure at one limb transfers to the whole system dysfunction . 1.1. State-Dependent Vasomotion and Neural Oscillations as Proximal Drivers of Influx While prior models have proposed cardiac and respiratory pulsatility as potential inputs for perivascular transport, more recent work in vivo using fiber photometry, opto-genetics, and multi-echo fMRI has shown that slow vasomotion, starting frequencies < 0.1 Hz, is the true driver for glymphatic influx .

1061 (1) doi.org

One result of increased arterial stiffness is transfer of cardiac flow pulsatility to the less compliant small blood vessels of the brain, resulting in increased mechanical stress on those vessels that eventually culminates in microhemmorhage (Henskens et al., 2008; Mitchell et al., 2011; O'Rourke & Safar, 2005; Ohmine et al., 2008; Tsao et al., 2013; Zieman, Melenovsky, & Kass, 2005) (Kiechl & Willeit, 1999). Another result of increased arterial stiffness is enhancement of cardiac wave reflection, i.e., a greater amount of oxygenated blood returning back up the descending aorta toward the heart rather than further down the vascular tree, resulting in less efficient oxygen transfer to smaller blood vessels including those in the brain. Second, elevated cholesterol promotes deposition of atherosclerotic plaque, leading to ischemic infarction and alterations to the fluid dynamics of blood flow through stenotic blood vessels supplying the brain (Amarenco et al., 1994; Manolio et al., 1999; Tell, Crouse, & Furberg, 1988). (2014)

1062 (1) doi.org

... an arterial catheter. Hemodynamic parameters such as CO, SV, SVV, and systemic vascular resistance (SVR) are calculated every 20 seconds with a proprietary algorithm using pulse contour analysis. SV is derived from the equation: K Pulsatility (standard deviation of the arterial pressure wave over 20 seconds), where K is a constant. K is derived from the sex, age, height and weight according to methods described by Langewouters et al. and the skewness and kurtosis of the individual arterial waveform. K is recalculated automatica

1063 (1) discovery.fiu.edu

... via DOI: 10.3390/s140712127 Web of Science: 000340035700046 Vascular contrast in narrow-band and white light imaging. 53:4061-4071. Full Text via DOI: 10.1364/AO.53.004061 Web of Science: 000338442800031 Oscillatory shear stress created by fluid pulsatility versus flexed specimen configurations. 17:728-739. Full Text via DOI: 10.1080/10255842.2012.715157 Web of Science: 000334049900005 Three-dimensional printing of tissue phantoms for biophotonic imaging. 39:3010-3013. Full Text via DOI: 10.1364/OL.39.003010 Web of Science: 000336982500048 Abstract

1064 (1) patents.google.com

... the stent within the arterial system of the patient, various forces may act on the stent, reducing its lifecycle and/or performance. Such forces may include biomechanical forces due to musculoskeletal and respiratory motions, cardiac pulsatility, swallowing, and head rotation. Stent fracture, often linked to undesirable clinical events, may be reduced by accurate modeling of interaction between musculoskeletal and arterial systems of a patient, with improved endovascular device design. Accordingly, patient-specific modeling of musculoskeletal and arterial systems of a patient may provide a means to improve the prediction of stent and/or endovascular device lifecycles. In other words, the systems

1065 (1) liu.se

... early post-intervention (one day), and at one month follow-up. Median perfusion and oxygen saturation values from predefined regions of sole of the foot were calculated during a 10-min recording. Additionally, the perfusion pulsatility was computed. Microcirculation perfusion and pulsatility and TP increased significantly one day after intervention, while tcP02 didn't increase until 1 month follow-up. In conclusion, this multimodal imaging system is a promising device allowing for global assessment of microcirculatory changes in the whole foot as well as in selected regions of interest. Further studies are warranted to determine

1066 (1) www.sheffield.ac.uk

Dawson J, Rothman A, Lawson A & Wartolowska K (2021) Design of a randomised, double-blind, crossover, placebo-controlled trial of effects of sildenafil on cerebrovascular function in small vessel disease: Oxford haemodynamic adaptation to reduce pulsatility trial (OxHARP). European Stroke Journal , 6(3), 283-290. Errington N, Iremonger J, Pickworth JA, Kariotis S, Rhodes CJ, Rothman AMK, Condliffe R, Elliot CA, Kiely DG, Howard LS , Wharton J et al (2021) A diagnostic miRNA signature for pulmonary arterial hypertension using a consensus machine learning approach. EBioMedicine , 69,

1067 (1) doi.org
... aortas, modeled as circular tubes with static constrictions, can result in detectable sound when sound generation is coupled with hemodynamics. The authors, however, do not account for dynamic valve motion or the effects of flow pulsatility which influence transient blood flow patterns in the aorta. Through this investigation, we provide the first of its kind description of physiologically realistic fluid-structure interaction (FSI) inside the ascending aorta with healthy and stenotic TAVs and the consequent sound generation and propagation in the surrounding tissue-like material. Further, we present a proof-of-concept analysis of a novel, data-driven, inexpensive, and safe method to process such heart sounds recorded on a patient's thorax and subsequently infer the health of the v (2021)

1068 (1) worldwide.espacenet.com
For blood pump systems intended for use to increase the overall diameter and lumen diameter of a blood vessel, the pumping of blood is monitored and adjusted, as necessary, to maintain the desired elevated blood velocity and wall shear stress, and the desired pulsatility in the target blood vessel in order to optimize the rate and extent of the persistent increase in the overall diameter and lumen diameter of the target blood vessel.

1069 (1) patents.google.com
In other embodiments, the control system includes sensors in the blood pump or conduits that measure at least one of a blood velocity, a blood flow rate, a resistance to blood flow in a peripheral blood vessel, a blood pressure, a pulsatility index, and combinations thereof. (2021)

1070 (1) ppubs.uspto.gov
In other embodiments, the control system includes sensors in the blood pump or conduits that measure at least one of a blood velocity, a blood flow rate, a resistance to blood flow in a peripheral blood vessel, a blood pressure, a pulsatility index, and combinations thereof. (2019)

1071 (1) patents.google.com
In other embodiments, the control system includes sensors in the blood pump or conduits that measure at least one of a blood velocity, a blood flow rate, a resistance to blood flow in a peripheral blood vessel, a blood pressure, a pulsatility index, and combinations thereof. (2019)

1072 (1) worldwide.espacenet.com
A blood pump system configured to pump blood into a peripheral vein for at least 1 day, wherein, when the system is operation, the mean wall shear stress in the peripheral vein is in

the range of 2.5 to 10.0 Pa and the pulsatility in the outflow conduit is reduced, the centrifugal blood pump system comprising: (2020)

1073 (1) www.researchgate.net
An important aspect of choosing between these two modes is understanding the consequences of each mode on pediatric vascular pulsatility. (2022)

1074 (1) [doi.org](doi.org)
The MCA peak flow 12% and pulsatility index ↓ 13%. The $PetCO_2$ from 37 to 40 mmHg soon after donning.

1075 (1) ppubs.uspto.gov
Providing ultrasound waves to a target tissue may modify the fluid dynamics of that target tissue such that is affected.

1076 (1) [doi.org](doi.org)
... but these dynamic effects do not significantly affect the evaluation of high shear stress found far downstream in the vessel/graft anastomosis. In this study, non-pulsatile arterial flow was modeled. The arterial flow velocity pulsatility would not have significant impact on the results as Symphony flow velocities (3 - 7 m/s) are significantly greater than arterial flow velocities (~0.2 m/s). There is a potential for the membrane to come in contact with housing briefly during device ejection, which may cause blood trauma and hemolysis due to the 'squeezing' of the blood between the membrane and the housing. The 'squeezing' effect was not modeled in the CFD. However, all animal experiments clearly and repeatedly demonstrated low levels of hemolysis, which are well-below clinical thresholds. These findings are consistent with results of others (2011)

1077 (1) ppubs.uspto.gov
... used for diagnosis of conditions such as stenosis, emboli, hemorrhage, sickle cell disease, ischemic cerebrovascular disease, vasospasm, and cerebral circulatory arrest. For measuring ICP using TCD, blood flow metrics such as systolic and diastolic wavers, pulsatility index (PI) and the Lindegaard ratio (LR) in major arteries at the base of the skull (the Circle of Willis) are used in statistical or physiological models to extract ICP. TCD is not alone reliable for ICP or brain monitoring, and high end ultrasound scanners are typically limited in the frame rate, bulky, and expensive. Moreover, TCD s

1078 (1) doi.org
... steady flow, impedance can be thought of as the opposition to pulsatile flow.33,34 Impedance is determined by both the resistance and compliance of the circuit (as well as parameters related to the fluid and pulsatility).35,36 Circuit compliance is an important consideration that has been shown to affect cardiac function and RV load, particularly for long term support.37 This is seen in normal, healthy pulmonary circulation as well. In addition to having low resistance to steady flow (relative to systemic arterial circulation), the natural pulmonary circulation displays enhanced vascular distention (compliance) which is important in allowing pressures in these vessels to remain low.33,38 ALs that have higher than physi (2018)

1080 (1) doi.org
Children with end-stage lung failure awaiting lung transplant would benefit from improvements in artificial lung technology allowing for wearable pulmonary support as a bridge-to-transplant therapy. (2020)

1082 (1) pubmed.ncbi.nlm.nih.gov
Arteriovenous fistulae (AVF) are the preferred choice of vascular access in hemodialysis patients; however, complications such as stenosis can lead to access failure or recirculation, which reduces dialysis efficiency. This study utilized computational fluid dynamics on a patient-specific radiocephalic fistula under hemodialysis treatment to determine the dynamics of access recirculation and identify the presence of disturbed flow. Metrics of transverse wall shear stress (transWSS) and oscillatory shear index (OSI) were used to characterize the disturbed flow acting on the blood vessel wall, while a power spectral density (PSD) analysis was used to calculate the any turbulence within the access. Results showed that turbulence is generated at the anastomosis and continues through the swing segment. The arterial needle dampens the flow as blood is extracted to the dialyzer, while the venous needle reintroduces turbulence due to the presence of jet flows. Adverse shear stresses are present throughout the vascular access and coincide with these complex flow fields. The position of the needles had no effect in minimizing these forces. However, improved blood extraction may occur when the arterial needle is placed further from the anastomosis, minimizing the effects of residual turbulent structures generated at the anastomosis. (2019)

1088 (1) encyclopedia.pub
Rhee, S.H. Application of the Design of Experiments and Computational Fluid Dynamics to Bow Design Improvement. J. Mar. Sci. Eng. 2019, 7, 226. Gupta, S.K. Response surface methodological (RSM) approach for optimizing the removal of trihalomethanes (THMs) and

its precursor's by surfactant modified magnetic nanoadsorbents (sMNP) - An endeavor to diminish probable cancer risk. Sci. Rep. 2019, 9, 18339. Kleijnen, J.P.C. Response surface methodology. Int. Ser. Oper. Sci. 2015, 216, 81 - 104. Asante-Sackey, D.; Pillay, L.V.; Kweinor Tetteh, E. Ion Exchange Dialysis for Aluminium Transport through a Face-Centred Central Composite Design Approach. Processes 2020, 8, 160. Pillay, V.L.; Mophethe, M.; Asante-Sackey, D. The Development and Evaluation of a Donnan Dialysis Process for the Recovery and Reuse of Aluminium from Potable Water Treatment Residual Streams Report to the Water Research Commission; Water Research Commission: Pretoria, South Africa, 2018; ISBN 978-1-4312-0999-6.

1089 (1) www.nature.com
T. et al. High fidelity computational simulation of thrombus formation in Thoratec HeartMate II continuous flow ventricular assist device. Sci Rep. 6, 38025 (2016). Morbiducci, U., Ponzini, R., Grigioni, M. & Redaelli, A. Helical flow as fluid dynamic signature for atherogenesis risk in aortocoronary bypass. A numeric study. 40, 519 - 534 (2007). Wen, J., Zheng, T. H., Jiang, W. T., Deng, X. Y. & Fan, Y. B. A comparative study of helical-type and traditional-type artery bypass grafts: numerical simulation. ASAIO (2022)

1091 (1) doi.org
... lens. Then, the change in focal length at the tilted incidence was analysed mainly using simulation and experiments. In 2020, Lightz-Nunez et al. proposed a linear Fresnel reflector optimisation method based on computational fluid dynamics, entropy yield, and evolutionary planning methods. The objective function of the optimisation process considered the maximization of the absorbed radiant solar flux on the receiver tube and the minimization of the total entropy yield. In summary, non-dominance ranking uses the concept of Pareto optimal solutions to rank individuals in a population so that individuals with a higher non-dominance status are ranked first. This allows the super

1097 (1) doi.org
This study addresses the persistent challenge of thrombosis formation in dialysis catheters by investigating the incorporation of helical flow inducers, a strategy inspired by the naturally occurring helical blood flow in arterial systems. In this research, helical flow inducers with varying pitch and diameter were integrated into the widely used Niagara@ catheter. Computational fluid dynamics simulations were conducted to evaluate the impact on key parameters such as local normalized helicity (LNH), residence time (RT), shear stress, and flow velocity.

1098 (1) doi.org

Newly created arteriovenous fistulas (AVFs) often fail to mature for dialysis use due to disturbed blood flow at and near the AVF anastomosis. The disturbed flow inhibits the endothelial nitric oxide synthase (NOS3) pathway, thus decreasing the production of nitric oxide, a vasodilator. Previously, our group reported that NOS3 expression levels affect AVF lumen size in a mouse model. In this study, we performed MRI-based computational fluid dynamics simulations to investigate the hemodynamical parameters (velocity, wall shear stress (WSS), and vorticity) in a mouse AVF model at day 7 and day 21 post-AVF creation using three NOS3 strains: overexpression (OE), knockout (KO), and wild-type (WT) control.

1100 (1) doi.org

The dialysis tubes were completely immersed in 20 mL release medium and stored at 100 rpm in a 37 °C incubator. At a predetermined time interval, 2 mL of the release medium was retained and replaced with an equal amount of fresh release medium to maintain the settling conditions. The concentration of CCM was determined using a UV-Vis spectrophotometer. 2.7. Stability of AC3-I@NPs in Solution To investigate the stability of the nanoparticles, the AC3-I@NPs were dispersed in pH 7.4 phosphate-buffered saline (PBS) for 2 weeks. The solution was stored at 4 °C, and the diameter of the fluid dynamics was measured at different times using dynamic light scattering (DLS).

1101 (1) doi.org

However, catheters have complications such as high rates of infection and dysfunction compared with other forms of dialysis, associated with increased rates of morbidity and mortality in these patients . Different tip designs have been associated with different performances: the step tip is known to have elevated recirculation values in reverse mode, while a symmetric tip catheter is usually associated with lower recirculating flow. This symmetric design is often considered the best design available at present . Both in vitro and in silico studies have assessed catheter performance, to give insight on how to optimise catheter design. In vitro studies have used RA models to evaluate catheter performance. An idealized RA model was developed and an in vitro set up built for this purpose and an in vitro simulator of the RA was employed to study the movement and recirculation associated with different catheter designs . In silico studies have used computational fluid dynamics (CFD) to study blood flow patterns associated with different catheter designs, as well as evaluating recirculation and thrombosis. (2021)

1104 (1) doi.org

In this study, we investigated the hemodynamic characteristics of arteriovenous fistulas (AVFs) in murine models using micro-CT based computational fluid dynamics (CFD). By combining high-resolution micro-CT imaging with ultrasound flow measurements, our methodology offers a cost-effective and efficient alternative to traditional MRI-based approaches. CFD simulations performed at 7 and 21 days post-surgery revealed substantial temporal changes in both geometry and hemodynamics. Geometric analysis showed that the proximal artery diameter increased from 0.29 mm to 0.38 mm, whereas the initial 2 mm fistula segment showed a 21.6% decrease (0.74 mm to 0.58 mm).

1107 (1) doi.org

Several in vitro fluid dynamics assessments and animal experiments indicated that side-holes may increase the risk of CRT and CRBSI [6, 7, 19, 20]. However, side holes may provide benefits in aspirating acute thrombus and reducing maximum velocity and shear stress . Currently, the majority of studies investigating the effects of side-hole catheters on dialysis have focused on maintenance hemodialysis, with notable lack of high-quality RCTs.

1113 (1) www.sec.gov

... applications relating to nanoparticle technology. In August 2002, we filed a patent application covering the development of a new active pharmaceutical ingredient for the treatment of hyperphosphatemia (elevated serum phosphate levels) in patients undergoing kidney dialysis, as well as a new drug delivery system using inorganic ceramic nanoparticles. During 2002, three patents were awarded to us covering the production of titanium pigment and nanomaterials using our technology, which patents expire in 2019. All other applications are in the review process. The potential value of our titanium processing technology, and each application of it, lies in the likelihood that patents will be granted with respect to patent applications and that granted patents are valid and enforceable. We can provide no assurance that the patents requested in all patent applications material to our business will be granted or that granted patents will be enforceable. Our business would be materially adversely affected if one or more patent applications are not granted or if granted patents are determined to be unenforceable. Competition--the Titanium Processing Technology. - Our titanium processing technology is fundamentally different from current commercial processing techniques. Other processes are based on either a precipitation of particles from aqueous solution or the formation of crystallites from molten droplets of titanium oxide generated in high temperature flame reactors. Our process is a dense-phase crystal growth technique which controls crystal formation using a combination of mechanical and fluid dynamics and chemical and thermal control. Our process permits exceptional control over particle size, shape, and crystalline form. Our titanium processing technology produces discrete anatase crystals in nanometer sizes and may be doped to be thermally stable up to

800 degrees Centigrade. By remaining stable in high-temperature process (2003)

1116 (1) ppubs.uspto.gov

... the natural lung. In contrast to current microfluidic artificial lungs, each artificial capillary of the disclosed devices can be completely surrounded by the sweep gas, thereby increasing gas exchange efficiency relative to previous devices. Computational Fluid Dynamics (CFD; SolidWorks) can be used to visualize flow and shear distribution throughout the blood flow network, to verify pressure drop, and to configure the overall design before printing. The final 3D CAD design can be printed using the parameters developed above. A single device can be printed and tested before proceeding with additional printing. Testing can occur in the laboratory with saline, whole blood, and oxygen or air sweep gas to validate pressure drops and gas exchange as functions of flow rates. The methods and systems disclosed herein can result in advancements in the ability to simply and easily manufacture large area microfluidic artificial lungs, thereby accelerating the timeframe to clinical application of these devices. The methods and systems disclosed herein can be directed to a 3D printed artificial lung for large animal testing that can be subsequently translated to the clinical setting through its application in systems targeted at acute lung support for pulmonary rehabilitation. The resulting 3D printed PDMS flow networks can have uses in, for example, but not limited to, biorcactors, dialysis, and filtration processes. Example 2: Rolled-Membrane Microfluidic Artificial Lung Designed for Large-Area Manufacturing with Biomimetic Blood Flow Networks Described herein is a new manufacturing technology for a microfluidic artificial lung (µAL) in which the structure is assembled via a continuous "rolling" and bonding procedure from a single, patterned layer of polydimethyl siloxane (PDMS). The patterned PDMS can be rolled around a cylindrical substrate. In this rolling process, the bl

1118 (1) www.researchgate.net

... from biomass. The demonstration of the fermentation of biomass-generated producer gas to ethanol is the major focus of this article in addition to assessi... Incorporating nonideal reactors in a junior-level course busing computational fluid dynamics (CFD) B.J. Lawrence J.D. Beene Various aspects related to the incorporation of computational fluid dynamics (CFD) in a junior level chemical reaction engineering course at Oklahama State University are discussed. The students are taught to use CFD for predicting the single-reaction conversion of a species in a nonideal reactor. The last few weeks of the course are dedicated to t... Nitric Oxide Delivery in Stag

1122 (1) patents.google.com

... equal to 0.01). Other ranges are also possible. Advantageously, the compositions and articles described herein may have low sorption of substances such as therapeutic agents (and/or e.g., proteins) in the presence of a dynamic fluid comprising such substances. Such articles and compositions may be useful for use in subjects where, for example, the presence of the article should not substantially decrease the availability and/or concentration of therapeutic agents delivered to the subject (e.g., via the article). In some embodiments, administration of therapeutic agents via a fluid flowed within the articles described herein

1123 (1) ppubs.uspto.gov
... to 0.01). Other ranges are also possible. Advantageously, the compositions, devices, and devices described herein may have low sorption of substances such as therapeutic agents (and/or e.g., proteins) in the presence of a dynamic fluid comprising such substances. Such devices and compositions may be useful for use in subjects where, for example, the presence of the device should not substantially decrease the availability and/or concentration of therapeutic agents delivered to the subject (e.g., via the device). In some embodiments, administration of therapeutic agents via a fluid flowed within the devices described herein do not

1124 (1) doi.org
Three module types are compared with different internal topologies: tubular, isometric, and anisometric TPMS. First, this study includes a computational fluid dynamics (CFD) simulation of the internal hemodynamics, validated through experimental residence time distributions (RTD).

1128 (1) ppubs.uspto.gov
Recent techniques using membranes have advanced greatly from the viewpoint of fluid dynamics.

1131 (1) doi.org
Computational fluid dynamics allowed the prediction of gradient formation using a transient laminar flow simulation in a commercial printer cartridge filled with an AB material block system taking into account the typical shear-thinning material behavior using Ostwald de Waele's power law. (2022)

1132 (1) doi.org
In addition, CCTA-reconstructed three-dimensional geometry of coronary arteries can be used for computational fluid dynamics simulation of patient-specific hemodynamic parameters

(e.g., flow rate and FFR) to assess the risk of myocardial ischemia in CMD patients .

1134 (1) www.nature.com

Computational fluid dynamics for enhanced tracheal bioreactor design and long-segment graft recellularization

1136 (1) sbir.nasa.gov

Analysis of cryogenic systems sometimes requires computational fluid dynamics, especially when significant deformation or breakup of the liquid/gas interface occurs.

1137 (1) www.sbir.gov

... production and maintenance of densified propellants that support operations including transfer and low-loss storage are of prime interest for future space vehicle and ground launch processing facilities. Analysis of cryogenic systems sometimes requires computational fluid dynamics, especially when significant deformation or breakup of the liquid/gas interface occurs. For many components, or for settled conditions, a simpler fluid and thermal network approach may be sufficient. Of interest is the capability to tightly couple CFD and fluid/thermal network approaches, such as a fluid-thermal network analysis of an active pressure control system coupled to a CFD simulation of the fluid and thermodynamics occurring in a cryogenic storage tank. Methane In-Space Propulsion Technology Area: TA2 I

1139 (1) sbir.nasa.gov

... production and maintenance of densified propellants that support operations including transfer and low-loss storage are of prime interest for future space vehicle and ground launch processing facilities. Analysis of cryogenic systems sometimes requires computational fluid dynamics, especially when significant deformation or breakup of the liquid/gas interface occurs. For many components, or for settled conditions, a simpler fluid and thermal network approach may be sufficient. Of interest is the capability to tightly couple CFD and fluid/thermal network approaches, such as a fluid-thermal network analysis of an active pressure control system coupled to a CFD simulation of the fluid and thermodynamics occurring in a cryogenic storage tank. Z10.02Methane In-Space Propulsion Technology Area: