More specifically, this research has demonstrated a critical role for small scale shear gradients in inducing platelet clot formation. The research leading to the identification of this novel shear micro-gradient dependent platelet aggregation mechanism has resulted in the development of a novel microfluidics-based flow technology (Platelet-SMT) that utilises shear gradients to controllably induce platelet aggregation and thrombus development in vitro.

This technology has multiple applications in clinical settings.

Background

The formation of blood clots, or ‘atherosclerotic plaques/thrombi’, through the accumulation of platelets and fibrin remains the leading cause of illness and death in industrialised societies. Rupture of these atherosclerotic plaques can lead to blocked arteries or vasculature, localised tissue death due to lack of oxygen and ultimately organ failure. These plaques generally form at the points where arteries meet or at curvatures and can result from the change of blood flow (which can result in direct activation of platelets) or due to the high blood flow shear stress, caused by narrowing of the vessel due to plaque formation.

The greatest change in blood flow can occur during the development of the plaque, where the growing thrombus itself can modify blood flow, establishing a potentially dangerous cycle of flow-dependent platelet activation and accelerated thrombus growth.

Opportunity

Researchers from the Australian Centre for Blood Diseases (ACBD) have identified a key role for sudden alterations in blood flow in initiating platelet thrombus formation and growth at sites of vascular injury.

Advantages

- Involve simple procedures
- Deliver quick turnaround
- Require minimal blood sample volumes
- Have multiple clinical applications
- Assess platelet function over a broad range of blood flow conditions
- Allow precise control over the spatial location and extent of platelet thrombus formation
- Allow precise control over the dynamic differential blood flow rate control.

Platelet-SMT technical specifications

(Figure A) Schematic detailing the main components of the SMT device (lab-on-chip).

(A) 200 mL inlet reservoir for blood delivery.
(B) Trap to prevent microchannel fouling by particulate matter and/or micro-clots in the blood sample due to inadequate anticoagulation.
(C) Feeder channel connecting the trap zone with the micro-contraction.
(D) High-resolution micro-channel with defined strain rate micro-gradient geometry.
(E) Exhaust channel.
(F) Outlet connection to a syringe pump.

(Figure B) Microscopy image sequences of blood perfusion through three different iterations of the microchannel platform. The yellow arrows denote the points of initial aggregation [t = 0 s]. The white arrows designate the direction of blood flow. Note that in all cases the blood samples were pretreated with amplification loop blockers (ALB); apyrase (0.02 U/ml), MR2179 (100 mM) and 2-MeSAMP (10 mM); Indomethacin (10 mM) and hirudin (800 U/ml) for 10 min prior to perfusion.

(Figure C) Representative aggregation traces showing the response of ALB treated whole blood perfusion through the three microchannel cases in a. (scale bar = 15 mm).
Identified Market Needs

<table>
<thead>
<tr>
<th>Test Description</th>
<th>Market Need</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Pre-surgery screening test</td>
<td>Basic go/no-go test for screening patients at high risk of bleeding prior to surgery</td>
</tr>
<tr>
<td>2 Pre-surgery test for patients previously on anti-platelet therapy</td>
<td>Potentially a more specific pre-surgery test for patients that have been on anti-platelet therapy and stop taking this for surgery</td>
</tr>
<tr>
<td>3 Platelet function diagnosis</td>
<td>A more detailed test to diagnose a specific platelet dysfunction for patients with bleeding issues</td>
</tr>
<tr>
<td>4 Monitoring of anti-platelet therapy</td>
<td>Monitoring patients response to anti-platelet therapy such as Aspirin or Clopidogrel</td>
</tr>
<tr>
<td>5 Research tool for screening drug targets</td>
<td>High throughput for pharmaceutical companies to screen targets for anti-platelet development</td>
</tr>
</tbody>
</table>

Estimated Market Needs

<table>
<thead>
<tr>
<th>Test Description</th>
<th>Market Need</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Platelet function screening test</td>
<td>Small current market, massive un-met market demand, one estimate is US$1.7B</td>
</tr>
<tr>
<td>2 Platelet function diagnosis</td>
<td>Relatively specialised and smaller market, actual market size is unknown, un-met market need</td>
</tr>
<tr>
<td>3 Monitoring of anti-platelet therapy</td>
<td>Clearly a significant market need as indicated by competitor activity and a US reimbursement code</td>
</tr>
<tr>
<td>4 Research tool for screening drug targets</td>
<td>To be quantified, potentially a small number of high volume customers</td>
</tr>
</tbody>
</table>

Key researchers

Professor Shaun P. Jackson

Professor Shaun Jackson is a physician-scientist and an inventor on six international patents. Professor Jackson is the current Research Director of the Australian Centre for Blood Diseases (ACBD) at Monash University. He is also Head of Haemostasis and Thrombosis Reference Centre at the Alfred Hospital and holds Adjunct Professorial positions at The Scripps Research Institute, San Diego and the Baker Heart Research Institute, Melbourne.

He was the Co-founder, Board Member and Chief Scientific Officer for Kinacia Pty Ltd. He serves on the Scientific Advisory Board to the International Society of Thrombosis and Haemostasis and is a consultant to leading International Pharmaceutical, Biotechnology and Venture Capital Companies.

Professor Hatem H. Salem

Professor Hatem Salem, is Executive Director of the ACBD and a haematologist 'by trade' with a primary interest in the field of thrombosis. Professor Salem is also Director of Haematology at The Alfred Hospital, Co-Head of Central and Eastern Clinical School (Monash University – The Alfred campus) and Executive Director of the Australasian Society of Haemostasis and Thrombosis.

Key publications


Potential products

- Platelet Function Screening Device (low cost diagnostic tool)
- Platelet Dysfunction Diagnostic Device (specialist applications)
- Research Device (high-throughput drug screening)

Contact us

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