Intravasation-On-μDevice (INVADE): Engineering Dynamic Vascular Interfaces to Study Cancer Cell Intravasation

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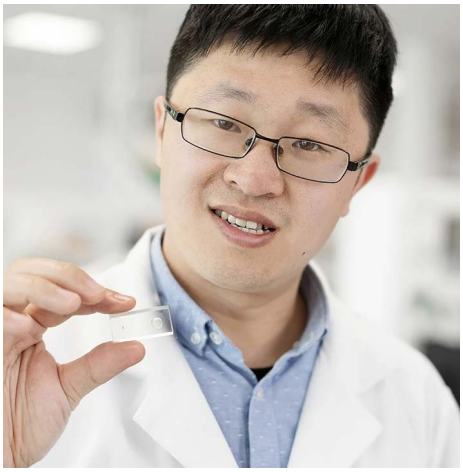
"We identified distinct cancer cell invasion strategies and discovered how cancer cells dynamically change their behaviour when interacting with blood vessels. The research has opened new avenues for developing treatments that could prevent cancer spread at its earliest stages. Most importantly, we discovered that blood vessel cells can actually suppress cancer cells' aggressive behaviour, providing a completely new understanding of how the body's own tissues interact with cancer during the earliest stages of spread."

🧬 What's the big idea?

This study is about understanding how **cancer cells spread** from their original location to other parts of the body—a process called **metastasis** that causes 90% of cancer deaths. The first step in this journey is **intravasation**, where cancer cells sneak into blood vessels. This is a critical and complex process, and scientists still don't fully understand how it works because it happens at such tiny scales and in real-time within the body.

🧪 What did the researchers do?



They created a **tiny lab-on-a-chip device** called **INVADE**, which mimics the environment of blood vessels. It allows scientists to watch cancer cells interact with blood vessel walls in real time over several days. This device has:

- **23 small chambers** where cancer cells live under conditions that mimic real tumours.
- A **channel lined with real human blood vessel cells** forming a functional barrier just like in the body.
- The ability to simulate **blood flow and pressure**, just like in the human body with precise control over shear stress (0.5-10 dyne/cm²).
- High-throughput capability allowing multiple experiments simultaneously, dramatically accelerating research.

🔍 **What did they discover?**

Using this device, they studied two types of breast cancer cells:

- **MCF-7** cells moved together in a group (like a team) in what's called "collective invasion".
- **MDA-MB-231** cells acted more independently and showed **three different behaviours** in "interactive invasion" mode:
    - Some cells led the way.
    - Some followed.
    - Some lagged behind.

They also found that:

- Cancer cells **change shape and behaviour** as they move.
- Blood vessel cells can **influence cancer cells**, making them less aggressive.
- Cancer cells can also **change the blood vessel cells**, making it easier to invade.

💡 **Why is this important?**

This new device helps scientists:

- Study cancer spread in a **controlled and realistic way** that was previously impossible with traditional laboratory methods.
- Discover **new behaviours** of cancer cells that weren't visible before, including the surprising finding that blood vessels can actually suppress cancer aggression.
- Develop **better treatments** by targeting specific steps in the metastasis process before cancer spreads throughout the body.
- Predict which patients' cancers are most likely to spread, helping doctors make better treatment decisions – this is now being applied to pancreatic cancer surgery planning with a new Tour de Cure grant.
- Replace some animal studies with more accurate human-based models, accelerating drug development while reducing costs and ethical concerns.