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Fingering instabilities in tissue invasion: an active fluid model

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We study theoretically a possible physical mechanism for formation of multicellular protrusions in carcinoma at the onset of metastasis. We suggest it might be a consequence of a very simple physical instability resulting from coupling between cell velocity and direction of active traction. It is reminiscent of the classical viscous fingering instability. We use it to show that, for a carcinoma growing in an external environment of comparable viscosity, even weak active traction can lead to the onset of multicellular protrusions, initiating metastasis. We also discuss how further evolution of the fingers would proceed within this model. Due to the simplicity of the mechanism proposed, we think it might be applicable for a wide range of circumstances and might rationalize fingering observed in vivo.

Primary author: Mr BOGDAN, Michal (University of Cambridge, Department of Engineering)

Co-authors: Ms MULARD, Aude (University of Cambridge); Dr SAVIN, Thierry (University of Cambridge)

Presenter: Mr BOGDAN, Michal (University of Cambridge, Department of Engineering)

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