Tim Bomberna

EVALUATING THE IMPACT OF CATHETER TYPE ON LOCAL HEMODYNAMICS TO IMPROVE TRANSARTERIAL LIVER CANCER TREATMENTS

Tim Bomberna (1,2), Ghazal Adeli Koudehi (1,2), Chris Verslype (3), Lawrence Bonne (4), Geert Maleux (4,5), Charlotte Debbaut (1,2)

(1) Biommeda, Ghent University, Ghent, Belgium
(2) Cancer Research Institute Ghent (CRIG), Ghent, Belgium
(3) Department of Clinical Digestive Oncology, University Hospitals Leuven, Leuven, Belgium
(4) Department of Radiology, University Hospitals Leuven, Leuven, Belgium
(5) Department of Imaging and Pathology, KU Leuven, Belgium

In the era of 'precision medicine', patient-specific models of drug particle transport in the hepatic arteries (HA) can offer valuable insights into current transarterial therapies for unresectable hepatocellular carcinoma. Here, two catheters (the standard microcatheter (SM, Terumo, Japan) and anti-reflux catheter (ARC, Surefire, USA)) were compared for their impact on local intrahepatic hemodynamics.

First, the arterial network of a patient-specific healthy liver was reconstructed in SpaceClaim[1]. Then, the SM (length: 28 mm, diameter: 0.93 mm) and the ARC (with an expanded funnel; total length: 40 mm, min-max diameter: 0.93-3.58 mm) were introduced to the lumen of the proper HA. Both models were meshed in Fluent Meshing[1], using $12 \cdot 10^6$ (SM) and $19 \cdot 10^6$ tetrahedral elements (ARC). Steady simulations of blood flow through the HA and microcatheter were run in Fluent[1]. A uniform blood velocity of 0.15 m/s and 0.2 m/s was specified at the HA and catheter inlet, respectively; outlet outflow was determined by Murray's law.

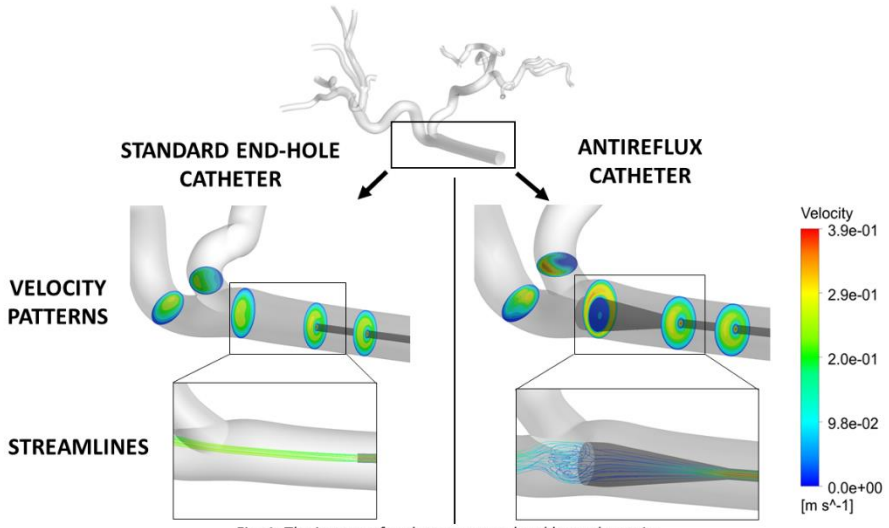

Fig. 1: The impact of catheter type on local hemodynamics

The velocity patterns (Fig. 1) show a low-velocity zone (blue) near the ARC tip. Particle pathlines are assumed to follow blood streamlines (Fig. 1), which exit the SMC in a controlled, laminar manner – in contrast to the ARC, where a much less orderly recirculation region occurs after the tip.

In summary, modelling different catheter types *in silico* can offer vital information on local blood flow patterns – which can influence downstream drug distribution – and inspire the quest for more efficient cancer therapies.

[1] Ansys, Canonsburg, USA