Downsampling CT Perfusion Imaging for Pancreatic Cancer: A Blood Flow and Cell Density Analysis

Zainab Zahra[1,3,4], Jin-Young Bang[1], Daniel Breadner[1,2,4], Stewart Gaede[1,2,4] and Ting-Yim Lee[1,3,5]

[1]Department of Medical Biophysics, Western University, [2]Department of Oncology, Western University, [3]Robarts Research Institute, [4]Verspeeten Family Cancer Centre, LHSC, [5]Lawson Research Institute, St. Joseph's Health Care

Verspeeten Family Cancer Centre
London Health Sciences Centre

Western

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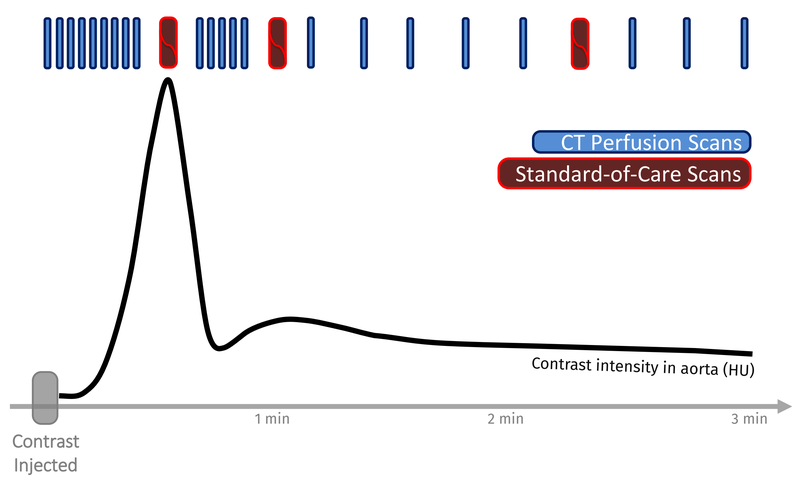
INTRODUCTION

- **High-dose radiotherapy temporarily increases tumour blood perfusion** – potentially improving the efficacy of subsequent systemic therapies in highly hypoxic and fibrotic pancreatic tumours.[1,2]
- Tumour response can be non-invasively assessed using **CT Perfusion (CTP)** imaging via serial contrast-enhanced imaging (32 images).
  - ❖ Blood flow & cell density are key prognostic metrics in pancreatic tumours.
- **CTP is an additional scan** beyond the clinical standard-of-care (SOC) 3-image pancreatic protocol. Concerns over increased contrast and radiation dose reduce CTP's clinical acceptance.

Schematic of Ideal Merged CTP Pancreatic Protocol

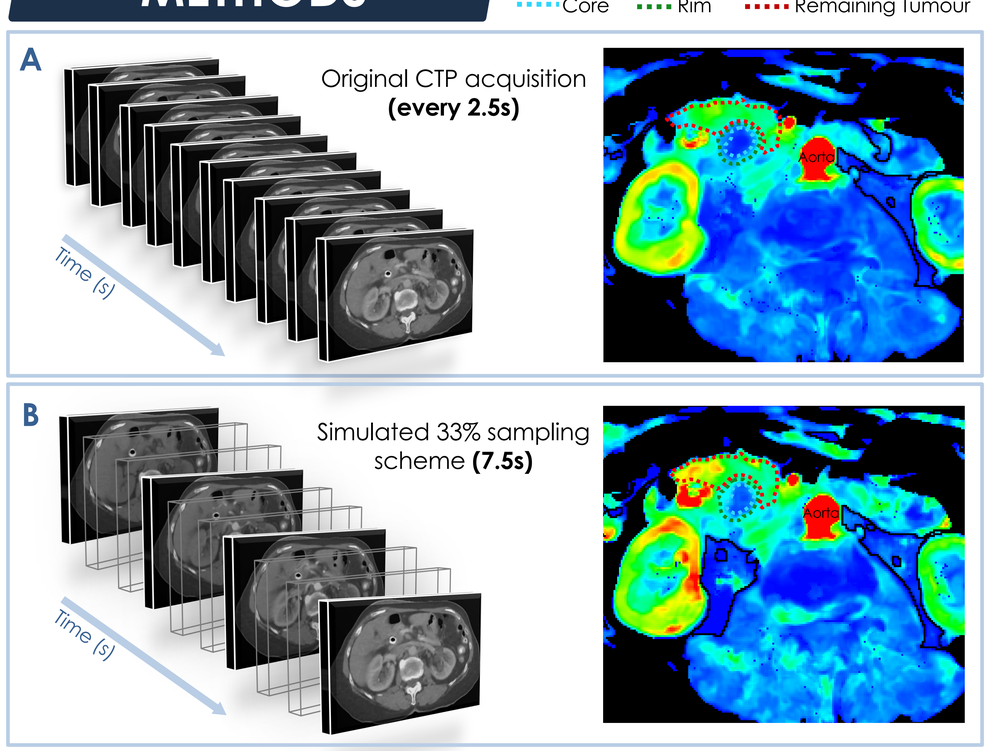


A merged CTP and SOC scan protocol would complement clinical metrics with functional hemodynamic information – without a separate protocol.

OBJECTIVE

To determine whether reduced CTP image acquisition rates yields comparable accuracy of hemodynamic metrics in pancreatic perfusion studies.

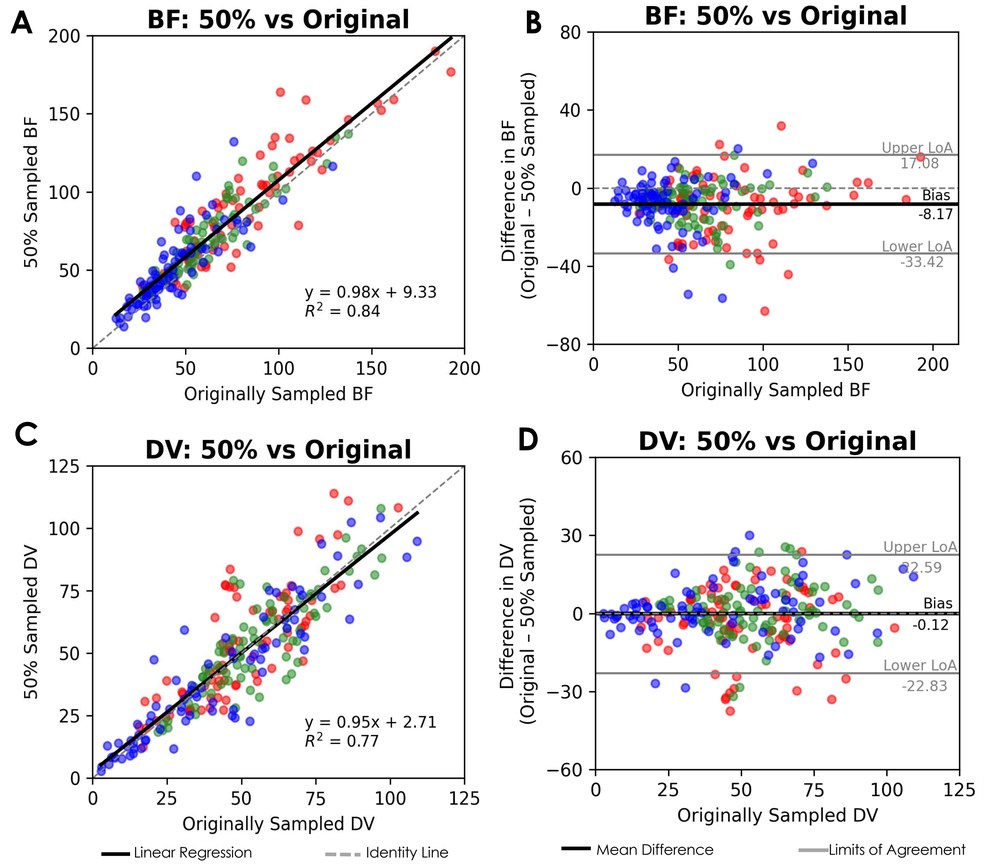
METHODS



▲**Figure 1.** CTP scan sampling schemes and blood flow maps with regions of interest for a representative patient. (A) original 2.5s sampling scheme, and (B) 33% downsampled scheme. *CTP = computed tomography perfusion.*

- n=5 pancreatic cancer patients treated with chemotherapy and high-dose radiotherapy.
- Pre- & post-treatment CTP images (acquired at 2.5s intervals) were **temporally downsampled to 50%, 33% and 25%.**
- Blood flow (BF) and contrast distribution volume (DV) voxel maps were generated for each sampling scheme (Fig.1).
  - ❖ DV is a surrogate marker for cell density.
- Three regions of interest (ROI) drawn over 5-7 slices.
- BF and DV values were **analyzed against their original values.**

RESULTS



- **50% temporally sampled** imaging scheme demonstrated the strongest agreement and correlation to the original sampling rate.
- 25% sampling scheme may outperform the 33% in some metrics.
- Potential to **utilize various sampling frequencies** at different parts of contrast perfusion.

◀ **Figure 2.** Representative correlation plots (A,C) and Bland-Altman agreement plots (B,D) comparing the 50% sampling scheme to the original temporal sampling scheme of 2.5s.

Plots A and B analyze blood flow (BF) in ml/min/100g tissue, with coefficients of determination (R^2) values from the linear regression are displayed. Plots C and D analyze the contrast distribution volume (DV) in ml/g.

CONCLUSION

- ➢ **CTP images acquired every 5s (as opposed to 2.5s) yielded comparably accurate quantifications of key indicators of tumour hemodynamics.**
- ➢ Reduced CTP image acquisition may facilitate clinical integration with SOC imaging to establish one multi-functional pancreatic protocol.
  - ➔ A merged CTP pancreatic protocol – with irregular image acquisition rates – is being tested and validated in a pig model.

REFERENCES

[1] Sato et al. *Cancer Science* 2023, *114*(9), 3487–3495

[2] Bang J-Y et al. *Frontiers Oncology* 2026; *16*:1677923

CONTACT & ACKNOWLEDGEMENTS

Zainab Zahra zzahra2@uwo.ca
Ting-Yim Lee tlee@uwo.ca

LAWSON Research Institute ST. JOSEPH'S HEALTH CARE LONDON
GE Healthcare
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