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Real-time evaluation of Hepatic Perfusion using Indocyanine Green Fluorescence Imaging in Hypothermic Machine Perfusion



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Introduction

Assessment of liver perfusion is a critical step in the pre-implantation phase of liver transplantation, particularly when the graft has undergone machine perfusion—either normothermic or hypothermic. In this context, indocyanine green (ICG) serves as a valuable non-invasive diagnostic tool for real-time monitoring of tissue perfusion and hepatic function. ICG is a fluorescent dye with high affinity for plasma proteins, rapidly taken up by hepatocytes and excreted into bile without undergoing metabolism. Its near-infrared fluorescence properties enable real-time visualization of intrahepatic vascular distribution, aiding evaluation of graft viability, especially in marginal organs.

Methods

Seven human livers (5 DCD, 2 ECMO DBD) were evaluated using hypothermic oxygenated machine perfusion (DHOPE). Upon completion of the perfusion protocol, each liver was injected with 25 mg of ICG via the portal vein and hepatic artery. A near-infrared imaging system assessed fluorescence distribution and vascular homogeneity across the hepatic parenchyma. The pattern and intensity of fluorescence were documented and analyzed semi-quantitatively.

Results

Seven grafts from extended criteria donors (5 DCD, 2 ECMO DBD) underwent DHOPE for an average of 140 minutes (range 120–186) and were assessed with pre-implantation ICG-NIR imaging. Early homogeneous distribution of the tracer was observed in 4 cases. The total ischemia duration was similar between groups. A non-homogeneous fluorescence pattern was associated with post-reperfusion syndrome, higher lactate peak (8.2 vs 4.7), elevated cytolytic enzymes (average 2295, range 1355–3057 vs 534, 197–989), and prolonged hospital stay (average 20 vs 12 days). No adverse events related to ICG were reported (Figure 1).

Conclusion

ICG fluorescence imaging is a feasible and informative tool for evaluating hepatic perfusion in hypothermic machine-perfused grafts. It enables real-time assessment of intrahepatic vascular distribution and may help identify grafts at risk of primary non-function. This technique could complement conventional perfusion markers in transplantation decision-making.

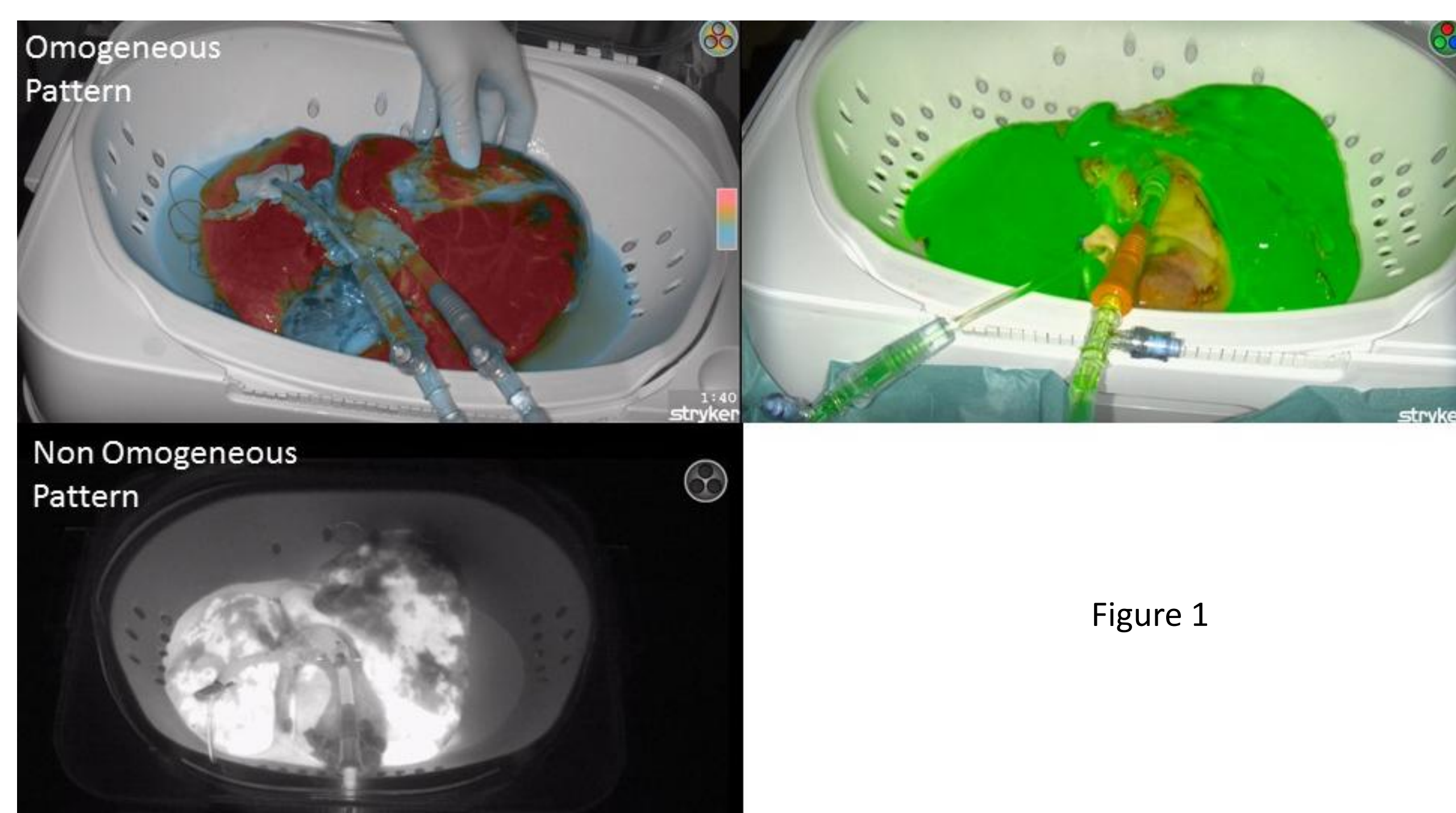


Figure 1