Purpose: To produce typical clinical time-attenuation curves (TACs) using a novel, previously validated, dynamic flow imaging phantom with the goal of developing a Quality Assurance protocol for DCE-CT allowing the quantification and validation of DCE-CT measurements under realistic flow conditions.

Materials: Using a two-compartment flow phantom a DCE-CT quality assurance protocol was developed and performed to investigate image noise, partial volume effects and CT number accuracy of the arterial input and their resulting output functions. Scans were performed using two imaging protocols one low dose and large slice thickness (80kV, 100mA, 2.5mm) and one with higher dose and smaller slice thickness (80kV, 300mA, 1.25mm). The protocol was performed on a GE Discovery ST 16-slice scanner and a Toshiba Aquilion One 320-slice scanner.

Results: Validation of the flow phantom demonstrated its capability of creating a wide range of clinically relevant TACs reproducibly with minimal error between experiments (StdErr<1.2%, n=3) and being predictable to a high degree of accuracy (R-squared>0.95). The effect of ROI size on the arterial input function (AIF) was investigated to determine an operating range of ROI sizes which were minimally affected by noise for small ROI radii and partial volume effects for large ROI radii. The resulting ROI radius operating range for the Toshiba was between 1.5-3.2mm for the low-dose protocol and 1.4-3.0mm for the higher dose, while the GE scanner was 1.5-2.6mm and 1.1-3.4mm for low and high dose respectively. This QA protocol also provides the ability to evaluate the effect of the AIF error on kinetic model parameter predictions.

Conclusions: The low-dose protocol resulted in only minimal differences in the operating range for the ROI size of the AIF when compared to the higher dose protocol. This phantom and QA protocol can be utilized under realistic flow conditions to compare different CT scanners and imaging protocols.