ASE2022 HYBRID
June 10-13, 2022 • Seattle, WA

Automated Analysis of Segmental Longitudinal Strain in Ischemic Heart Disease

William Hawkes[1*], **Ashley Akerman**[1*], Tine Deschamps[1*], Andrew Parker[1*], Jamie O'Driscoll[1,2,3*], Rajan Sharma[2], Gary Woodward[1*].
1: Ultromics Ltd, Oxford, United Kingdom.
2: St Georges University Hospitals Trust, London, United Kingdom.
3: Canterbury Christ Church University, Canterbury, United Kingdom.

INTRODUCTION

The clinical interpretation of myocardial ischemia during stress echocardiography is a manual process done by eye, and is therefore subject to variability. Automated quantification of segmental longitudinal strain (SLS) has the potential to provide valuable information to augment the clinical assessment of myocardial ischemia.

AIM

The aim of this work was to evaluate the validity of regional longitudinal strain quantification produced by a commercially available automated echocardiographic analysis software compared to the visual assessment of regional ischemia by cardiac physiologists.

METHOD

- 188 participants were collected from routine stress echocardiograms at clinical St George's Hospital.
- Left ventricular peak systolic SLS values were obtained from the apical 2 and 4 chamber views using the AI-driven software EchoGo Core v2.0.
- No manual correction or editing of automated analysis was permitted.
- Regional ischaemia was defined as the observation of regional wall motion abnormalities (RWMAs) by three qualified cardiac physiologists.
- Operators were asked to score RWMAs using the 18-segment model with the following criteria:
  - 1: Normal
  - 2: Hypokinetic
  - 3: Akinetic
- Ischaemic burden was estimated by the number of segments with RWMAs.
- Agreement in the observation of RWMAs between operators was assessed using the intraclass correlation coefficient using a two-way random effects model using the absolute agreement on the mean of readers.
- Differences in SLS between normal, hypokinetic and akinetic segments was assessed using analysis of variance (ANOVA) and subsequent t-test.
- ROC curve analysis was used to predict the presence of operator identified RWMAs using SLS values.

RESULTS

RWMAS: INTER OPERATOR AGREEMENT

RWMAs were identified in 85 patients (45.2%). Agreement between operators across all observations (n=1617) was high, with an ICC of 0.953 (0.94, 0.96). This was due to operators tending to agree on segments with normal wall motion. However, agreement dropped when assessed at the level of individual segments (Figure 1). The basal anterior and basal anteroseptal were segments where inter-operator agreement was 0.59 (0.37, 0.72) and 0.57 (0.29, 0.73), respectively. The ICC for other segments ranged from 0.74 to 0.87. Apical segments tended to display the highest agreement.

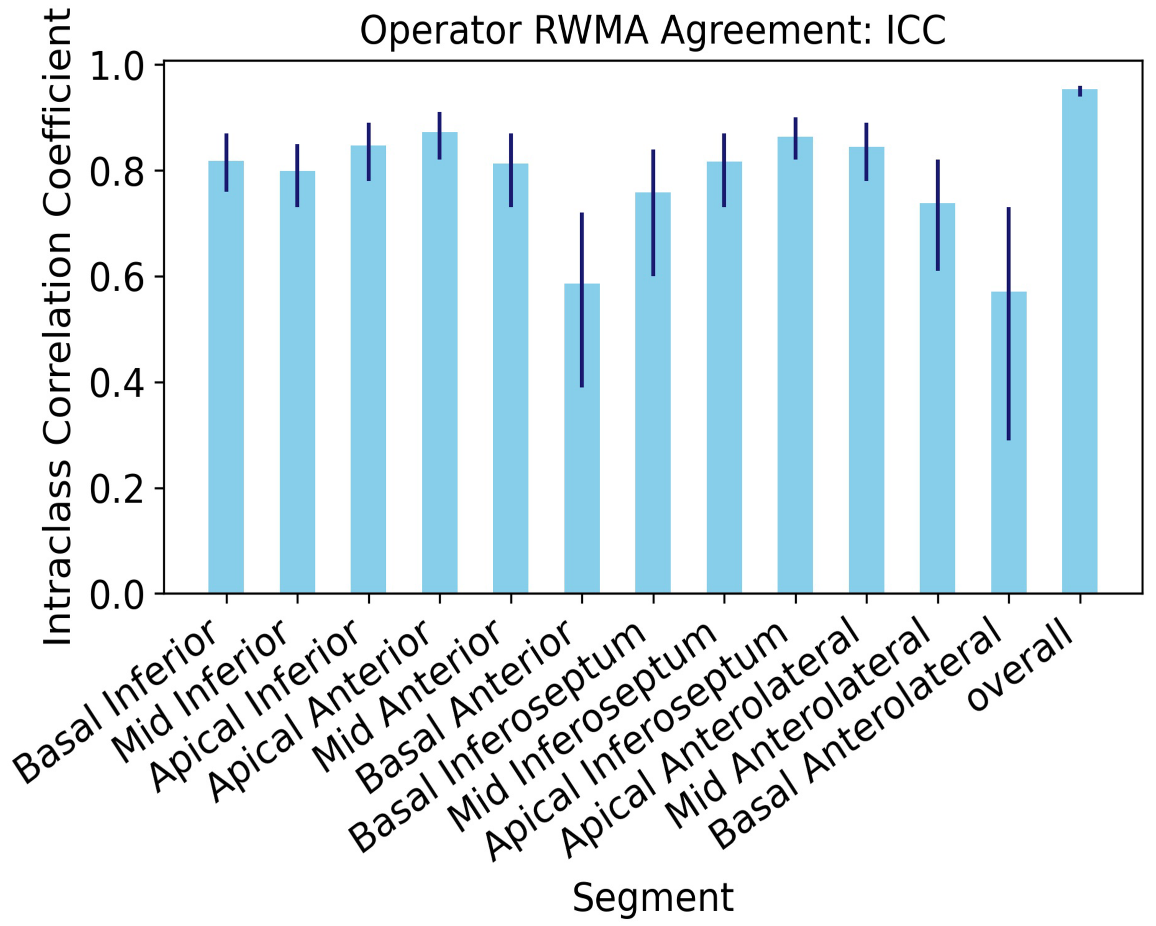

Figure 1: Inter-operator agreement on RWMA scores. Agreement is calculated using the intraclass correlation coefficient. Error bars represent the 95% confidence interval.

AUTOMATED ANALYSIS OF SEGMENTAL LONGITUDINAL STRAIN & ASSOCIATION WITH RWMAS

For all segments, the severity of RWMs had a significant effect on AI-assessed SLS (Figure 2A & 2D). The ability of ROC curves to Identify any RWMAs within individual segments achieved an area under the ROC curve (AUC) from 0.682 to 0.831 (Figure 2B & 2E, blue markers). Performance generally increased when focusing on akinetic segments only, with AUROCs ranging from 0.711-0.949 (Figure 2B & 2E, red markers).

The ischemic burden could also be predicted using SLS, with an AUROC of 0.689-0.805 for 1 to 2 segments with RWMAs and an AUROC of 0.785-0.981 for 3 or more segments with RWMAs (Figure 2C & 2F).

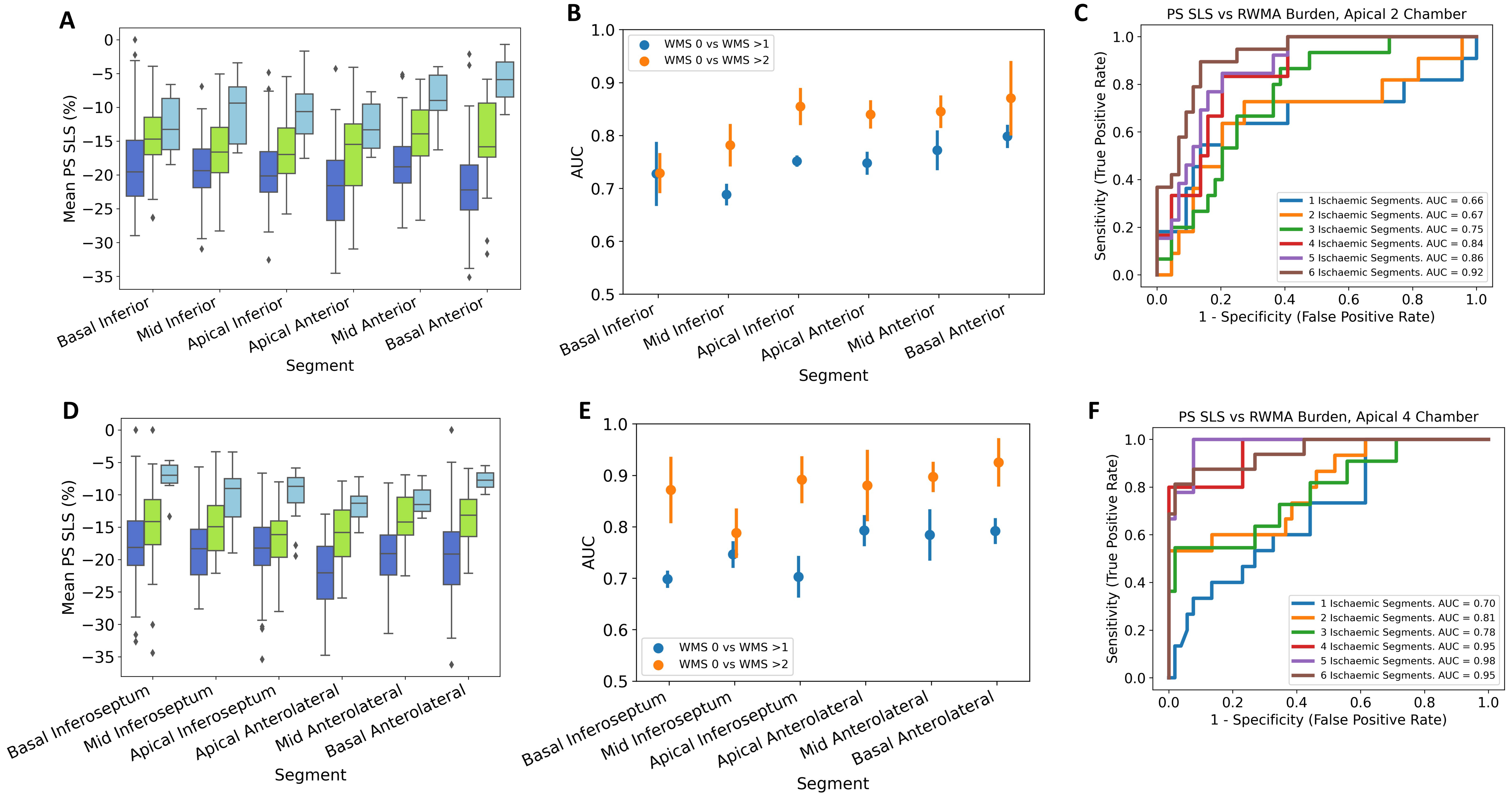

Figure 2: Automated assessment of SLS and prediction of RWMA from apical two chamber (A, B & C) and apical four chamber (D, E & F) views. B & E present the mean ± SEM AUC for prediction of RWMAs identified by each operator and the median of all operators using SLS. C & F present prediction of RWMA burden using SLS to predict the median number of ischemic segments.

CONCLUSIONS

Fully automated assessment of SLS in patients with suspected ischemic heart disease is feasible and is indicative of RWMAs. This data suggests that automated SLS values have potential to provide useful, unbiased information to aid in the detection of myocardial ischemia.

*Conflicts: * Employees of Ultromics Ltd*