Objective: To compare a Convolutional Neural Network (CNN) with manual PVC localization of left vs. right ventricular (RV vs. LV) OT PVC.
Methods: All patients with successful ablation of RV-LV OT from 1/2013-1/2020 were included if they had at least one standard 12-lead ECG recorded with a clinical PVC before ablation. PVC origin was defined by the site of successful ablation excluding LV summit, aorto-mitral continuity and para-hisian PVCs. Success was defined as absence of the targeted PVC for the 24 hr post procedure monitoring. We compared CNN performance to 3 OT PVC localization algorithms (Table 1). Patient-level ECG data were split into Training, Validation and Test Datasets in a ratio of approximately 7:1:2. Results are reported as averaged across 10 random splits of the data and model initializations for robustness.
Results: 308 ECGs (86 RVOT, 43 LVOT, 179 sinus) from 75 patients were used for CNN development. CNN classified RVOT PVC with similar sensitivity to algorithms but with higher specificity (Table 2). For LVOT PVC, CNN specificity was higher, and sensitivity was higher than all but one, of the manual algorithms. The CNN area under the receiver operating characteristic curve for LVOT and RVOT were 0.929 and 0.914, respectively.
Conclusion: A CNN can achieve higher specificity at similar or higher sensitivity compared to most published algorithms to differentiate right from left OT PVCs.

Table 1: Examples of manual algorithms to distinguish RVOT from LVOT PVC/VT

Author	Criteria	Original Study Sn/Sp
Betensky et al[1]	In patient with V3 transition in precordial leads, measure V2 transition ratio: (R/R+S) in VT divided by (R/R+S) in SR, if ≥0.6 suggestive of LVOT	Sensitivity 95%; Specificity 100%
Yoshida et al[2]	The V2S/V3R index was defined as the S-wave amplitude in lead V2 divided by the R-wave amplitude in lead V3 during the OTVT. The V2S/V3R index was significantly smaller for LVOT origins than RVOT origins (P < 0.001) with a cut-off value of 1.5 predicting an LVOT origin.	Sensitivity 89%; Specificity 94%
Cheng et al[3]	In patient with V3 transition three ratios were calculated: 1) the R-wave amplitude index, R-wave amplitude divided by QRS amplitude during PVCs/VT; 2) the R-wave deflection index, R-wave deflection interval divided by QRS duration during PVCs/VT; and 3) the R-wave duration index, R-wave duration divided by QRS duration during PVCs/VT. Lead V3 R wave deflection interval>80 ms and lead V1 R wave amplitude index>0.3 is suggestive of LVOT	Sensitivity 100%; Specificity 83%

OTVT: outflow ventricular tachycardia, RVOT : right ventricular outflow tract , LVOT: left ventricular outflow tract, PVC: premature ventricular complex, SR: sinus rhythm, CNN: convolutional neural network.
[1] Betensky BP et al. J Am Coll Cardiol. 2011 May 31;57(22):2255-62. PMID: 21616286.
[2] Yoshida N et al. J Cardiovasc Electrophysiol. 2014 Jul;25(7):747-53. PMID: 24612087.
[3] Cheng Z et al. Int J Cardiol. 2013 Sep 30;168(2):1342-8. PMID: 23273342.

Table 2: Comparing performance of a CNN to three published OTVT localizing algorithms in distinguishing RVOT from LVOT VT and vice versa.

	RVOT		LVOT	
	Sensitivity	Specificity	Sensitivity	Specificity
CNN	0.80	0.90	0.59	0.96
Betensky et al[1]	0.93	0.39	0.39	0.93
Yoshida et al[2]	0.90	0.67	0.67	0.90
Cheng et al[3]	0.89	0.47	0.46	0.89

[1] Betensky BP et al. J Am Coll Cardiol. 2011 May 31;57(22):2255-62. PMID: 21616286.
[2] Yoshida N et al. J Cardiovasc Electrophysiol. 2014 Jul;25(7):747-53. PMID: 24612087.
[3] Cheng Z et al. Int J Cardiol. 2013 Sep 30;168(2):1342-8. PMID: 23273342.

B-PO01-089

SUDDEN CARDIAC ARREST DURING THE COVID-19 PANDEMIC: SIGNIFICANT EFFECTS ON INCIDENCE AND OUTCOMES

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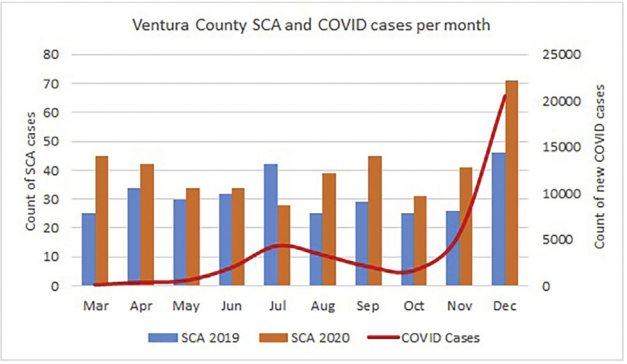
Background: Recent reports suggest that higher COVID-19 incidence may be associated with higher out-of-hospital sudden cardiac arrest (SCA) burden and worse outcomes.
Objective: To compare SCA incidence and outcomes during the COVID-19 pandemic (March 1 - Dec 31, 2020) to the corresponding period in 2019 in a US community.
Methods: All out of hospital SCA cases with likely cardiac etiology attended by emergency medical services (EMS) were prospectively identified during the COVID-19 pandemic period in Ventura County, CA (pop. 848,112). We compared SCA incidence, resuscitation variables (Utstein elements) and outcomes in 2020 to 2019. COVID monthly counts were obtained from US Centers for Disease Control data.
Results: In 2019 there were 314 SCA cases in Ventura County (average 31.4 per month), corresponding to a 10-month incidence of 36.9 per 100,000. In 2020 there were 410 SCA cases (41.0 per month; 30% higher than 2019 average), for a 10-month incidence of 48.2 per 100,000 ($p<0.001$). A spike in both COVID and SCA incidence was observed in December 2020 (Figure). The proportion of SCAs with shockable rhythm also declined (25% to 19%, $p=0.05$), as did survival to hospital discharge (14.7% to 8.8%, $p=0.01$). There were no significant differences in the percent with witnessed arrest (48% to 43%, $p=0.20$), bystander CPR (54% to 48%, $p=0.10$), and return of spontaneous circulation (33% to 28%, $p=0.15$).
Conclusion: SCA incidence was significantly higher and survival outcomes lower during the COVID-19 pandemic period, with evidence of overlap between the two conditions. These findings have implications for community public health and EMS response planning during the pandemic and subsequent outbreaks.



B-PO01-090

PROSPECTIVE ASSESSMENT OF AN AUTOMATED INTRAPROCEDURAL ECG-BASED SYSTEM FOR LOCALIZING VT EXIT SITES IN PATIENTS WITH STRUCTURAL HEART DISEASE (SHD)

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Background: We have previously developed an intraprocedural automatic arrhythmia origin localization (AAOL) system to localize idiopathic ventricular arrhythmia origins onto patient-specific electroanatomic (EAM) surface in real time using a 3-lead ECG.
Objective: To assess the localization accuracy of ventricular tachycardia (VT) exit and premature ventricular complex (PVC) origin sites in patients with SHD using the AAOL system.
Methods: In retrospective and prospective cohorts, a total of 42 patients who underwent VT/PVC ablation in the setting of SHD were recruited at two different centers. The AAOL system combines 120-ms QRS integrals of 3 leads (III, V2, V6) with pace mapping to predict VT exit/PVC origin site and projects that site onto the patient-specific electroanatomic surface. VT exit/PVC origin sites were clinically identified by contact mapping. The localization error of the VT exit/PVC origin site was assessed by the distance between the clinically identified site and the estimated site.
Results: In the retrospective cohort of 19 patients with SHD, the AAOL system achieved a mean localization accuracy of 6.5 ± 2.6mm for 25 induced VTs. In the prospective cohort with

23 patients, mean localization accuracy was 5.9±2.6mm for 26 VT exit and PVC origin sites (Figure 1). There was no difference in mean localization error in epicardial sites compared to endocardial sites using the AAOL system (6.0 *vs.* 5.8 mm, P =0.895). Figure 1 shows an example of VT exit site localization.

Conclusion: The AAOL system achieved accurate localization of VT exit/PVC origin sites in patients with SHD that is superior to current system, which supports the potential clinical utility.

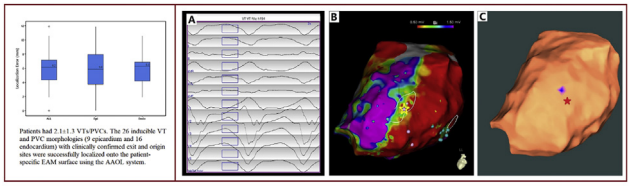

Figure 1 (Left panel) shows box plot of localization errors between clinically-identified VT exit/PVC origin sites and sites estimated by the AAOL in a prospective cohort. The ALL plot represents the aggregate of all VTs and PVCs. Epi indicates epicardial VTs and PVCs; and Endo indicates endocardial VTs and PVCs. (Right panel) (A) shows the recorded 12-lead ECG of an induced epicardial VT during the procedure for a patient. (B) illustrates the epicardial EAM bipolar potential map of the LV for this patient, with the VT exit site (identified by contact mapping) depicted by the yellow star. (C) shows that the AAOL system was used to predict a VT exit site marked in the blue patch on the apical inferolateral LV wall of the epicardial EAM geometry when using all recorded 9 pacing sites of the VT, having a localization error of 8.2 mm in comparison with the actual VT exit site indicated by the red star.

B-PO01-091

PREDICTORS OF CONCEALED MYOCARDIAL SCAR ON CARDIAC MAGNETIC RESONANCE IN PATIENTS WITH APPARENTLY IDIOPATHIC VENTRICULAR ARRHYTHMIAS: THE ALARM RISK SCORE

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Background: In patients (pts) with apparently idiopathic ventricular arrhythmias (VAs), cardiac magnetic resonance (CMR) with late gadolinium enhancement (LGE) may reveal concealed myocardial scar which increases the arrhythmic risk during follow-up. However, systematic implementation of CMR for pts with idiopathic VAs is costly and impractical, and criteria to refine patient selection are needed.

Objective: To create a scoring system based on clinical and VAs characteristics to refine the pts selection for CMR imaging.

Methods: 815 consecutive pts (61% males, median age 45 [31-55] years) with apparently idiopathic non-sustained VA (normal 12-lead ECG and normal echocardiogram) underwent CMR. Clinical characteristics as well as VAs features (burden, morphology and QRS fragmentation) were collected. To develop the scoring system predicting the presence of CMR abnormalities, we divided the pts into 2 datasets: 572 (70%) randomly selected pts were used to generate the score (derivation set), and 243 (30%) were used for its validation. The risk score was created from the odds ratio (OR) obtained at multivariable logistic regression analysis rounded to the nearest integer.

Results: Left-ventricular LGE was documented in 126 (16%) pts. The ALARM risk score was derived from the independent predictors of LGE at multivariable analysis: Age ≥30-years (3 points, p=0 006), maLe sex (5 points, p<0 001), fAmily history of sudden death/cardiomyopathy (2 points, p=0 04), RBBB-superior axis morphology (7 points, p<0 001) and Multifocal VAs (8 points, p<0 001). The ALARM score ranged from 0 to 25 The score C-statistics were 0 84 (p=0 02), 0 82 (p=0 04), and 0 83 (p=0 02) for the derivation set, validation set, and all pts, respectively. The probability of CMR abnormalities ranged from 3% for the first tertile of score (<5 points), to 11% for the second tertile (5-8 points), and 47% for the third tertile (≥8 points).

Conclusion: The ALARM risk score based on patient characteristics and VAs feature predicts the presence of CMR abnormalities in pts with apparently idiopathic VAs and helps to identify those to most likely benefit from CMR assessment.

B-PO01-092

USING PULSED ELECTRIC FIELDS TO CAUSE FOCAL FIBROSIS IN THE INTERVENTRICULAR SEPTUM

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Background: Pulse electric fields (PEF) are being investigated as an alternative ablation modality to traditional radiofrequency ablation for modification of myocardial substrate.

Objective: Assess the extent and time course of myocardial scar formation caused by application of PEF at the interventricular septum.

Methods: Four-week survival experiments were performed in 8 canines. Energy was delivered using ablation catheters in bipolar configuration to apply PEF to the septum. Two animals were administered pulses at microsecond pulse widths and six received nanosecond pulses for a total 75-189 J delivered per animal. MRI studies were performed in 4 of the 8 animals. Scar formation was assessed by measuring late gadolinium enhancement (LGE) and confirmed by histology.

Results: Sites of PEF delivery exhibited myocardial edema on triple inversion recovery and early scar with some LGE visible after 7 days. Lesion volumes were larger for transmural configurations vs. bipolar PEF delivered in a single cardiac chamber ($10.7 \pm 2.3\ cm^3$ vs. $2.9 \pm 1.1\ cm^3$). At 30 days, lesions predominantly exhibited LGE and total lesion volumes were similar for both groups ($5.3 \pm 2.4\ cm^3$ vs. $4.0 \pm 0.2\ cm^3$). Transmural MRI lesions were achieved when bipolar electrodes were placed on either side of the septum, and total lesion volume was dose-dependent. Myocardial fibrosis was identified on histology. Bipolar configurations entirely within a chamber produced superficial lesions, even with delivery of higher energy.

Conclusion: Application of PEF to the myocardium can cause substrate modification, including transmural fibrosis. Lesion volume is dose-dependent for transmural electrode configurations.