

AUDIOELECTRIC CARDIOGRAPHIC PARAMETERS FOR THE BEDSIDE DETECTION OF HEART FAILURE

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BACKGROUND

- HF is a common clinical condition resulting in frequent ED and clinic visits.
- Standard 12 lead EKG and auscultation for an S3 gallop are frequently performed.
- The value of an auscultated S3 has been diminished by reports of poor accuracy.
- We investigated computerized audioelectric cardiographic parameters, including the S3, in a variety of clinical settings.

HYPOTHESIS

- A combination of ECG and cardiac acoustical data can:
 - Distinguish between subjects with and without HF.
 - Identify chronic HF patients with advanced disease severity.

METHODS

- Patient Population:
 - 264 pts presenting to the UCMC ED with dyspnea
 - 100 chronic HF pts followed in the UNC HF clinic receiving an EKG
 - 1149 asymptomatic volunteers
- Exclusion Criteria:
 - Age < 30 or Heart Rate >115

METHODS CONTINUED

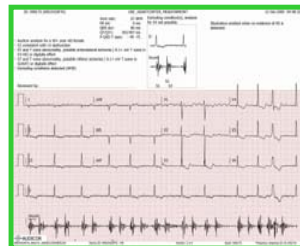
- Audioelectric cardiographic leads (Audicor™, Inovise Medical Inc.) were attached to the V3 and V4 sensors on the EKG leads, and connected to a GE MAC 5000.
- A 3-minute audioelectric cardiographic tracing was obtained.
- A technician, blinded to all clinical and diagnostic testing, selected a 10 sec segment.
- A physician, blinded to the Audicor results, examined the pt and auscultated for an S3.
- Patient demographics were collected from the chart.
- Statistics: Student's t-test and Chi-square test

SAMPLE EKGs

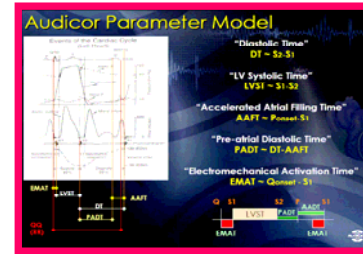


No S3 Detected

S3 Present



RESULTS



Heart Failure versus No Heart Failure

	Normal Volunteers	UNC	UCMC No HF	UCMC HF	UCMC p value
Age	64 ± 15 (n=1149)	59 ± 13 (n=96)	57 ± 14 (n=134)	67 ± 16 (n=130)	
Female	58%	27%	59%	49%	
African American	N/A	39%	47%	55%	
BNP/ProBNP*	N/A	2592 ± 4803 (n=77)	86 ± 128 (n=74)	1210 ± 1332 (n=124)	0.000
Heart Rate	72 ± 13	70 ± 15 (p=0.000)	82 ± 16 (p=0.000)	82 ± 16 (p=0.000)	0.871
Audicor S3	10%	29% (p=0.000)	10% (p=0.790)	41% (p=0.000)	0.000
Auscultated S3	N/A	24%	3% (n=129)	17%	
PR Interval	166 ± 29 (n=1083)	179 ± 35 (p=0.000) (n=78)	155 ± 26 (p=0.000) (n=129)	166 ± 37 (p=0.891) (n=101)	0.007
QRS Duration	101 ± 21	128 ± 39 (p=0.000)	92 ± 18 (p=0.000)	116 ± 33 (p=0.000)	0.000
Diastolic Time/RR	0.61 ± 0.05 (n=1142)	0.63 ± 0.06 (p=0.000) (n=78)	0.61 ± 0.05 (p=0.282) (n=131)	0.60 ± 0.06 (p=0.038) (n=126)	0.470
LV Systolic Time/RR	0.39 ± 0.05 (n=1142)	0.37 ± 0.06 (p=0.000) (n=84)	0.39 ± 0.05 (p=0.188) (n=132)	0.40 ± 0.06 (p=0.034) (n=126)	0.539
Accel Atrial Filling Time	262 ± 34 (n=1083)	302 ± 43 (p=0.000) (n=78)	251 ± 32 (p=0.000) (n=129)	280 ± 45 (p=0.000) (n=101)	0.000
Pre-Atrial Diastolic Time	276 ± 128 (n=1076)	292 ± 175 (p=0.297) (n=78)	229 ± 134 (p=0.000) (n=127)	176 ± 125 (p=0.000) (n=96)	0.003
EMAT	97.6 ± 18.7	126.3 ± 25.6 (p=0.000)	96.0 ± 16.1 (p=0.329)	115.9 ± 22.0 (p=0.000)	0.000
EMAT/RR	0.12 ± 0.03	0.15 ± 0.04 (p=0.000)	0.13 ± 0.03 (p=0.000)	0.16 ± 0.04 (p=0.000)	0.000

p-values vs normals except for the last column
*ProBNP for UNC, BNP for UCMC
Mean ± SD

S3 Prevalence Audicor vs Auscultation

	Audicor S3	Auscultated S3	P value
UNC	29%	24%	0.415
UCMC HF	41%	17%	0.000
UCMC No HF	10%	3%	0.000

Chronic UNC Heart Failure Population

	ProBNP ≤ 1000 (n=39)	ProBNP > 1000 (n=38)	LVEF ≤ 35 (n=59)	LVEF > 35 (n=37)	Decompensated (n=22)
Age	54 ± 12	64 ± 14	57 ± 13	62 ± 13	60 ± 13
Female	33%	24%	17%	43%	32%
African American	43%	26%	42%	32%	50%
ProBNP	388 ± 276	4854 ± 6076	3276 ± 5346 (n=48)	1460 ± 3535 (n=29)	4916 ± 7556 (n=20)
EF	36 ± 15	30 ± 12	25 ± 8	49 ± 9	28 ± 14
Audicor S3	18%	42%	32%	24%	45%
QRS Duration	123 ± 36	139 ± 45 (p=0.000)	139 ± 41	109 ± 27 (p=0.000)	142 ± 47
EMAT	121.7 ± 21.8	134.8 ± 29.5 (p=0.029)	129.6 ± 27.1	121.0 ± 22.5 (p=0.109)	137 ± 29
EMAT/RR	0.14 ± 0.04	0.16 ± 0.05 (p=0.012)	0.16 ± 0.04	0.13 ± 0.04 (p=0.015)	0.16 ± 0.04

CONCLUSIONS

- The S3 was more frequently detected by the Audicor machine than by physicians in the ED.
- QRS duration was prolonged in pts with HF compared to those without.
- QRS duration was prolonged in pts with advanced disease.
- The electromechanical activation time (EMAT) was prolonged in pts with HF compared to those without.
- The EMAT was more prolonged in pts with advanced disease.
- The S3 prevalence in decompensated chronic HF pts (45%) was similar to the UCMC HF group (41%)
- Audioelectric cardiography is a new non-invasive method that may aid in evaluation of HF.