

**Left Ventricular Strain Predicts
Heart Failure Admissions in
African Americans with Heart Failure**

BY

IBRAHIM N. MANSOUR
M.D., Hacettepe University, Ankara, Turkey, 2001

THESIS

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Defense committee:

Jack Zwanziger, Chair and advisor
Thomas D. Stamos, Cardiology
Mayank Kansal, Cardiology

TABLE OF CONTENTS

<u>CHAPTER</u>	<u>PAGE</u>
I. BACKGROUND	1
II. METHODS	3
A. Study Population.....	3
B. Transthoracic Echocardiography and Global Longitudinal Strain	3
III. STATISTICAL ANALYSIS	5
IV. STUDY RESULTS.....	6
A. Study Population.....	6
B. Left Ventricular Global Longitudinal Strain.....	9
C. Left Ventricular Global Longitudinal Strain and All-cause Mortality	9
D. Left Ventricular Global Longitudinal Strain and Heart Failure Admissions.....	13
V. DISCUSSION.....	16
VI. STUDY LIMITATION.....	18
VII. CONCLUSION.....	19
VIII. REFERENCES	20
IX. VITA.....	22

LIST OF TABLES

<u>TABLE</u>		<u>PAGE</u>
I.	CLINICAL CHARACTERISTICS BY LV GLS.....	7
II.	UNIVARIATE ANALYSES FOR PREDICTION OF ALL-CAUSE MORTALITY AND HEART FAILURE ADMISSIONS.....	11
III.	MULTIVARIATE ANALYSIS FOR PREDICTION OF ALL-CAUSE MORTALITY.....	12
IV.	MULTIVARIATE ANALYSIS FOR PREDICTION OF HEART FAILURE ADMISSIONS	15

LIST OF FIGURES

<u>FIGURE</u>		<u>PAGE</u>
1.	Kaplan-Meier curves for all-cause mortality.....	10
2.	Kaplan-Meier curves for heart failure admissions.....	14

LIST OF ABBREVIATIONS

AA African American

CKD Chronic Kidney Disease

DM Diabetes Mellitus

HF Heart Failure

HTN Hypertension

LV Left Ventricle

GLS Global Longitudinal Strain

HR Hazard Ratio

NYHA New York Heart Association

LVEF Left Ventricular Ejection Fraction

ROC Receiver Operating Characteristic

TTE Transthoracic Echocardiogram

SUMMARY

Left ventricular global longitudinal strain (LV GLS) is a sensitive measure of LV mechanics that has been correlated with adverse events in patients with heart failure. Previous studies have included few African American (AA) patients.

We enrolled 207 AA adults, age 56 ± 14.5 years, with New York heart Association (NYHA) class I through III HF on optimal guideline-directed medical therapy (GDMT) from the University of Illinois HF clinic between November 2001 and February 2014. LV GLS was assessed by velocity vector imaging using 2, 3 and 4-chamber views. Patients were followed for HF admissions and death for 3 ± 3.0 years. LV GLS value of -7.95 was used as the optimal cutoff point that maximizes sensitivity and specificity

LV GLS $> -7.95\%$ was significantly associated with higher all-cause mortality and HF admissions in Kaplan-Meier survival curves (log-rank $P < 0.001$). After incorporated in a multivariate Cox proportional hazard models, GLS $> -7.95\%$ was found to be an independent predictor of all-cause mortality (HR=4.20; 95% CI 1.14-15.56; $p = 0.014$) and HF admissions (HR3.86; 95% CI 1.38-10.77; $p = 0.010$).

In AA patients with chronic stable HF on GDMT, more impaired LV GLS ($> -7.95\%$) is a strong and independent predictor of long-term all-cause mortality and HF admission.

I. BACKGROUND

Despite the advances in the diagnostic techniques and treatment for heart failure (HF), the disease burden continues to grow, affecting millions of people and accounting for well over a million hospitalizations annually.¹ Several prognostic indicators have been investigated in an attempt to identify those at highest risk of hospitalizations and morbidity. Reduction in left ventricular (LV) function has long been established as a strong predictor of mortality among patients with HF.² However, several more objective and possibly more sensitive methods for assessing LV function have been emerging, one of which includes left ventricular strain.

Left ventricular mechanics is a complex, coordinated action involving multidimensional movement including longitudinal and circumferential shortening and radial thickening.²⁻⁸ Myocardial strain is a method to measure these multidimensional movements, and may lead to a better understanding of myocardial deformation in left ventricular dysfunction. Strain can be determined by 2D speckle tracking, which is an echocardiographic method based on tracking of characteristic speckle patterns created by constructive and destructive interference patterns of ultrasound beams in the myocardium.⁴⁻⁹ Several studies have demonstrated the importance of global longitudinal strain (GLS) and strain rate (change in myocardial strain over time) as reliable indicators of prognosis in patients with acute and chronic systolic HF, post-myocardial infarction, and ischemic cardiomyopathy.^{9, 11-17} However, these studies have included few African Americans (AA) patients.

AA have a 50% higher relative incidence of heart failure, more advanced disease severity, and increased morbidity compared with the general population.^{10, 11} There has been a significant effort focused on identifying those patients at high risk of progressing to worsening heart failure and death; however there are few studies evaluating prognostic indicators unique to AA. One small study, which included equal proportions of African Americans and Caucasian, found that African Americans

(compared with whites) had disproportionately worse GLS and comorbidity burden, regardless of LV EF as determined by the echocardiographer.¹² Our aim is to assess the prognostic value of LV GLS as a predictor of HF admissions and all-cause mortality in the AA patient population.

II. METHODS

A. Study Population

A total of 207 AAs, aged ≥ 18 years, with Stage C HF and New York Heart Association (NYHA) class I through III symptoms, were enrolled from the heart failure clinic at the University of Illinois Hospital and Health Sciences System (UI-Health) between November 2001 and February 2014. All patients were on target or maximally tolerated doses of guidelines-directed medical therapy (GDMT) including angiotensin converting enzyme inhibitors or angiotensin receptor blockers (ACEI/ARB) and β -blocker therapy. Patients with active malignancy or acute coronary syndrome within two months were excluded.

The study protocol was approved by the UI-Health Institutional Review Board. All patients were provided written, informed consent for study participation. On the day of enrollment, a cardiologist performed a complete medical history and physical examination, and a clinical pharmacist obtained a medication history. Complete transthoracic echocardiograms (TTE) were performed and stored for analysis of echocardiographic parameters and LV strain. Demographic and clinical data were recorded from the electronic medical record. Heart failure admissions and all-cause mortality were prospectively tracked through the UI-Health electronic medical record chart reviews. The Social Security Death Index served as an additional source for patient survival status.

B. Transthoracic Echocardiography and Global Longitudinal Strain

Standard 4-chamber, 3-chamber and 2-chamber apical views and parasternal short-axis views of the left ventricle were obtained using a commercially available ultrasound system. All images were stored digitally and analyzed with offline software (Syngo Dynamics 9.0 software, Siemens Medical Solutions) by an independent investigator who was blinded to the clinical data. Standard echocardiographic data

were recorded including LV dimensions and ejection fractions, LV mass index, septal and posterior wall thickness, and left atrial volume according to published guidelines.¹³ Additionally, pulsed-wave Doppler mitral inflow peak E- and A-wave velocities, E-wave deceleration time, and pulsed-wave tissue Doppler of the lateral and septal mitral annular velocities (e'), and right ventricular (RV) systolic velocity (S') in the apical 4-chamber view were obtained.

Speckle tracking for myocardial strain was performed using Velocity Vector Imaging software (Siemens Medical Systems, Erlangen, Germany). The technical details have been previously described.⁶ Briefly, the software detects motion along a user-defined endocardial-tracing border by applying successive tracking steps. From this tracking, longitudinal strain is determined from the endocardial trace. The software calculated the average strain values for 6 LV segments for each of apical 2-, 3- and 4-chamber views (18 total segments). Peak global longitudinal strain (GLS) was defined as the peak negative value on the strain curve during the entire cardiac cycle averaged from the 18 segments. Assessment of LV was regarded as suboptimal when speckle tracking could not be obtained in <5 of the six myocardial segments in any one of the apical views. In the cases where there were suboptimal tracking in an apical view, GLS values were averaged from the analyzable views, as long as there were a minimum of two optimal apical views. All primary measurements were performed by a single researcher who was blinded to other clinical data.

III. STATISTICAL ANALYSIS

The number of patients and percentages were computed for categorical variables. Means, standard deviations, and medians were computed for continuous variables. The receiver operating characteristic (ROC) curve, which is a measure of the discriminatory power, was drawn to assess the ability of GLS to predict all-cause mortality and HF admissions. The optimal GLS threshold value was determined as the value, which maximizes average of sensitivity and specificity. Clinical characteristics were compared between patients with a GLS level above and below the threshold value (-7.95%), determined by the ROC curve, by the Chi-square test for categorical variables and t-test for continuous variables. Univariate and multivariate Cox proportional hazard models were used to look at the association of the GLS with the time to all-cause mortality and HF admissions. Accordingly, hazard ratios (HR) and 95% confidence interval (CI) were calculated. The Kaplan-Meier curves and log-rank tests were used to compare the times to all-cause mortality and the first heart failure admission across two GLS groups. Statistical analyses were conducted using IBM SPSS 21(Armonk, NY). The significance level was set at 0.05.

IV. STUDY RESULTS

A. Study Population

Of the 207 patients enrolled, 184 (89%) patients had LV GLS that could be measured. The mean age of the study population was 56.5 ± 14.5 years, 80(44%) were men and 39 (22%) had an ischemic heart failure etiology. The mean GLS in the study population was $-8.8 \pm 4.4\%$.

The area under the ROC curve for the prediction of all-cause mortality using LV GLS was 0.665 ($p=0.002$), and 0.593 for prediction of HF admission ($p=0.054$). The optimal GLS threshold value was -7.95% , corresponding to a sensitivity of 0.75 and specificity of 0.60 for prediction of all-cause mortality, and 0.63 and 0.60, respectively for the prediction for HF admission. GLS was above the threshold value of -7.95% in 85 (46%) patients. Baseline characteristics of patients with a GLS above and below the threshold value are summarized in TABLE I. Patients in the more impaired GLS ($\geq -7.95\%$) group had a higher percentage of male population ($p=0.003$), higher prevalence of atrial fibrillation/flutter ($p<0.001$), lower LVEF ($p<0.001$) and higher LV mass index ($p=0.001$). Other characteristics, including heart failure therapy, are summarized in TABLE I.

TABLE I. CLINICAL CHARACTERISTICS BY LV GLS

Characteristic	LV GLS		P Value
	≤ -7.95% n= 99	> -7.95% n= 85	
Age (years)	55.2 ± 15.2	58.0 ± 13.6	0.188
Male sex	33 (33%)	47 (55%)	0.003
BMI (kg/m ²)	34.5 ± 9.5	32.9 ± 10.5	0.285
BSA (m ²)	2.1 ± 0.3	2.1 ± 0.38	0.841
Hypertension	80 (81%)	67 (79%)	0.854
Atrial fibrillation/flutter	10 (10%)	32 (38%)	<0.001
Ischemic heart disease	17 (18%)	22 (27%)	0.205
CKD Stage III-V	32 (33%)	46 (43%)	0.218
Tobacco use	51 (52%)	47 (55%)	0.766
Cocaine abuse	4 (4%)	7 (8%)	0.351
Medication use			
ACE inhibitor or ARB	93 (95%)	80 (94%)	1.000
β-blocker	96 (98%)	84 (99%)	1.000
Hydralazine plus nitrate	8 (8%)	20 (24%)	0.007
Ca channel Blockers	28 (29%)	11 (13%)	0.012
Loop diuretics	78 (80%)	76 (91%)	0.063
Digoxin	23 (24%)	32 (38%)	0.052
Statin	50 (62%)	50 (68%)	0.503
NYHA functional class			
Class I	30 (31%)	17 (20%)	0.150
Class II	30 (31%)	24 (28%)	
Class III	38 (39%)	44 (52%)*	
Blood pressure (mmHg)			
Systolic	128.2 ± 24.9	122.3 ± 23.8	0.104
Diastolic	72.7 ± 13.1	72 ± 15	0.746
Heart rate (bpm)	72 ± 12	74.5 ± 15	0.192
S3 (%)	0 (0%)	4 (5%)	0.044
JVD, above 8 cm	4 (4%)	8 (9%)	0.230
Rales	1 (1%)	3 (4%)	0.337
LDL	94.5 ± 36.4	95.8 ± 32.9	0.809
Mean LVEF (%)	44.0 ± 9.0	24.3 ± 8.0	<0.001
LVEF <40%	35 (35%)	81 (95%)	<0.001
LV relative wall thickness (cm)	0.4 ± 0.2	0.2 ± 0.1	0.001

TABLE I. CLINICAL CHARACTERISTICS BY LV GLS CONT.

Characteristic	LV GLS		P Value
	$\leq -7.95\%$ n= 99	$> -7.95\%$ n= 85	
LV mass index (g/m ²)	101.6 ± 54.8	132.3 ± 63.5	0.001
LA volume (mm ³)	69.1 ± 26.8	92.4 ± 31.6	<0.001
Mitral E/A ratio	1.3 ± 1.0	1.9 ± 1.3	0.001
Mitral annulus TDI			
e' septal cm/s	6.2 ± 2.2	5.8 ± 2.54	0.351
e' lateral cm/s	9.3 ± 4.4	8.2 ± 3.7	0.101
E/e' average ratio	11.1 ± 7.7	12.3 ± 6.1	0.284

Mean ± SD or No (%).

*The only subgroup that was significantly different, however there was no overall significant difference.

BMI, body mass index; BSA, body surface area; ACE, angiotensin-converting enzyme; ARB, angiotensin receptor blocker; NYHA, New York Heart Association; bpm, beat per minute; S3, the third heart sound; JVD, jugular venous distension; LV GLS, left ventricular global longitudinal strain; LVEF, left ventricular ejection fraction

B. LV GLS

LV GLS was found to be significantly worse in males ($p=0.003$), patients with atrial fibrillation/flutter ($p<0.001$), and lower LVEF ($p<0.001$). Interestingly, it did not show a significant difference with age or in patients with hypertension, DM, CKD, or ischemic heart disease.

C. LV GLS and All-cause Mortality

Overall mean time to death or censoring was 3.6 ± 2.9 years, with a mean of 3.0 ± 2.6 years in the more impaired GLS group and 3.9 ± 3.6 years in the less impaired group. Thirty-six(20%) of the 184 patients died over the course of follow-up period: 26 (31%) died from the more impaired GLS group and 10 (10%) from the less impaired GLS group ($p<0.001$). The mean baseline GLS was $-6.9 \pm 4.7\%$ among patients who died and $-9.2 \pm 4.3\%$ among the survivors ($p=0.006$) at the end of study period.

Kaplan-Meier survival curves (Figure 1) demonstrated significantly higher all-cause mortality across time in the more impaired GLS group (log-rank $P< 0.001$). On univariate Cox proportional hazard analyses, more impaired GLS was significantly associated with all-cause mortality either as a continuous variable (HR 1.14; 95% CI 1.04-1.24; $p=0.004$) or dichotomous variable using the threshold of -7.95% (HR 3.74; 95% CI 1.79-7.80; $p<0.001$). Additional variables that were significantly associated with all-cause mortality in univariate analysis were age ($p=0.001$), ischemic heart disease ($p<0.001$), history of atrial fibrillation or flutter ($p<0.001$), CKD ($p<0.001$), and LV mass index ($p=0.003$) (TABLE II).

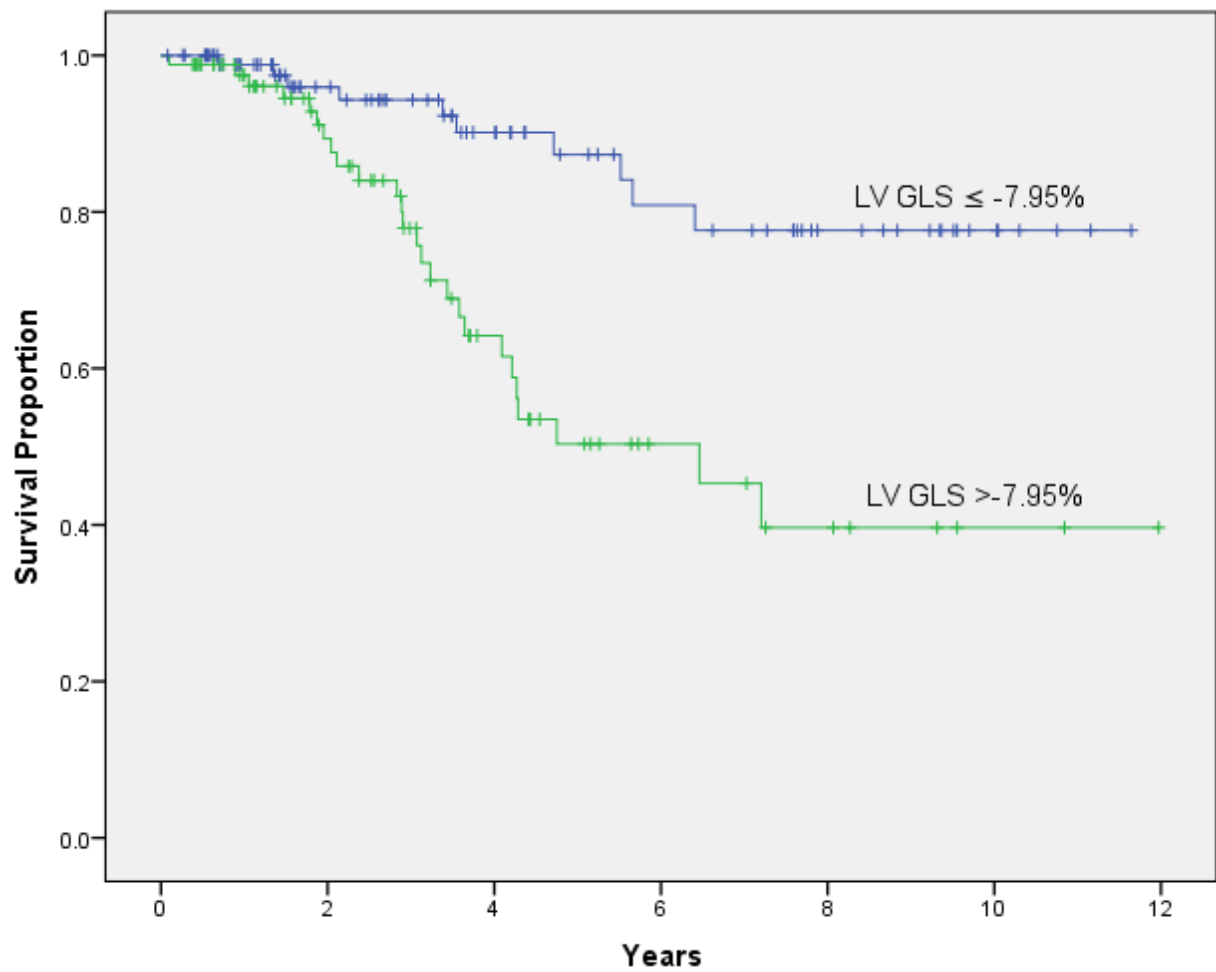


Figure 1. Kaplan-Meier curves of all-cause mortality for patients stratified by their left ventricular global longitudinal strain (LV GLS) > -7.95% vs. ≤ -7.95%. Log-rank $p < 0.001$.

TABLE II. UNIVARIATE COX REGRESSION HAZARD ANALYSIS FOR PREDICTION OF ALL-CAUSE MORTALITY AND HF ADMISSION

Variable	All-cause Mortality			HF Admission		
	HR	95% CI	p-value	HR	95% CI	P-value
LV GLS >-7.95%	3.74	1.79-7.80	<0.001	2.62	1.46-4.72	0.001
LV GLS as a continuous variable	1.14	1.04-1.24	0.004	1.08	1.01-1.16	0.021
LVEF	0.97	0.95-1.00	0.051	0.98	0.96-1.00	0.099
Age	1.04	1.02-1.06	0.001	1.02	1.00-1.04	0.017
Male	1.37	0.71-2.27	0.351	0.99	0.56-1.73	0.965
NYHA functional class II	1.90	0.73-4.91	0.186	2.34	0.95-5.75	0.064
NYHA functional class III	2.14	0.89-5.13	0.089	3.06	1.33-7.05	0.008
Ischemic heart disease	3.37	1.71-6.63	<0.001	1.79	0.97-3.29	0.063
Atrial fibrillation/flutter	3.93	1.95-7.91	<0.001	1.67	0.87-3.18	0.122
Chronic kidney disease	3.72	1.90-7.28	<0.001	2.52	1.44-4.43	0.001
Loop Diuretics	2.29	0.55-9.60	0.258	1.25	0.53-2.94	0.616
LV relative wall thickness (cm)	1.24	0.13-11.71	0.849	1.16	0.21-6.53	0.866
LV mass index (g/m ²)	1.01	1.00-1.02	0.003	1.00	1.00-1.01	0.456
Mitral E/A ratio	1.33	1.00-1.77	0.053	1.21	0.94-1.56	0.131

LVEF, left ventricular ejection fraction; NYHA, New York Heart Association; LV GLS, left ventricular global longitudinal strain

After incorporating age, sex, NYHA class, history of ischemic heart disease, CKD and LVEF in a multivariate model, GLS > -7.95% was found to be significant predictor of all-cause mortality (HR=4.20; 95% CI 1.14-15.56; p =0.014). GLS as a continuous variable was also found to be an independent predictor after incorporating age, sex, NYHA class, history of ischemic heart disease, CKD in the model (HR 1.2; 95% CI 1.02-1.24; p=0.017) (TABLE III).

TABLE III. MULTIVARIATE COX REGRESSION HAZARD ANALYSIS FOR PREDICTION OF ALL-CAUSE MORTALITY

Variable	All-cause Mortality		
	HR	95% CI	p-value
LV GLS >-7.95%	4.21	1.14-15.56	0.014
LVEF	1.02	0.97- 1.08	0.549
Age	1.01	0.97- 1.04	0.320
Male	1.74	0.78- 3.92	0.942
NYHA functional class II	1.42	0.49- 4.07	0.121
NYHA functional class III	1.98	0.70-5.58	0.023
Ischemic heart disease	2.08	0.94-4.58	0.537
Chronic kidney disease	2.84	1.12-7.20	0.114

LVEF, left ventricular ejection fraction; NYHA, New York Heart Assn; LV GLS, left ventricular global longitudinal strain

D. LV GLS and Heart Failure Admissions

Overall mean time to HF admission or censoring was 3.2 ± 3.0 years, with a mean of 2.5 ± 2.6 years for the more impaired GLS group and 3.8 ± 3.3 years for the less impaired GLS group. Forty-nine (27%) patients were admitted for HF over the course of follow-up period: 31 (37%) patients from the more impaired GLS group and 18 (18%) from the less impaired GLS group ($p=0.007$). The mean baseline LV GLS was $-7.7 \pm 4.2\%$ among patients who were admitted and $-9.1 \pm 4.5\%$ among the ones who were not ($P=0.058$).

Kaplan-Meier survival curves (Figure 2) demonstrated significantly higher HF admission rate in the more impaired GLS group (log-rank $p=0.001$). On univariate Cox proportional hazard analyses, more impaired GLS was significantly associated with HF admissions either as continuous variable (HR 1.08; CI 1.01-1.16; $p=0.021$) or dichotomous variable using the threshold of -7.95% (HR 2.62; 95% CI 1.46-4.72; $p=0.001$). Additional variables that were significantly associated with HF admissions in univariate analysis were age ($p=0.017$), NYHA class III ($p=0.008$), and history of CKD ($p=0.001$) (TABLE II).

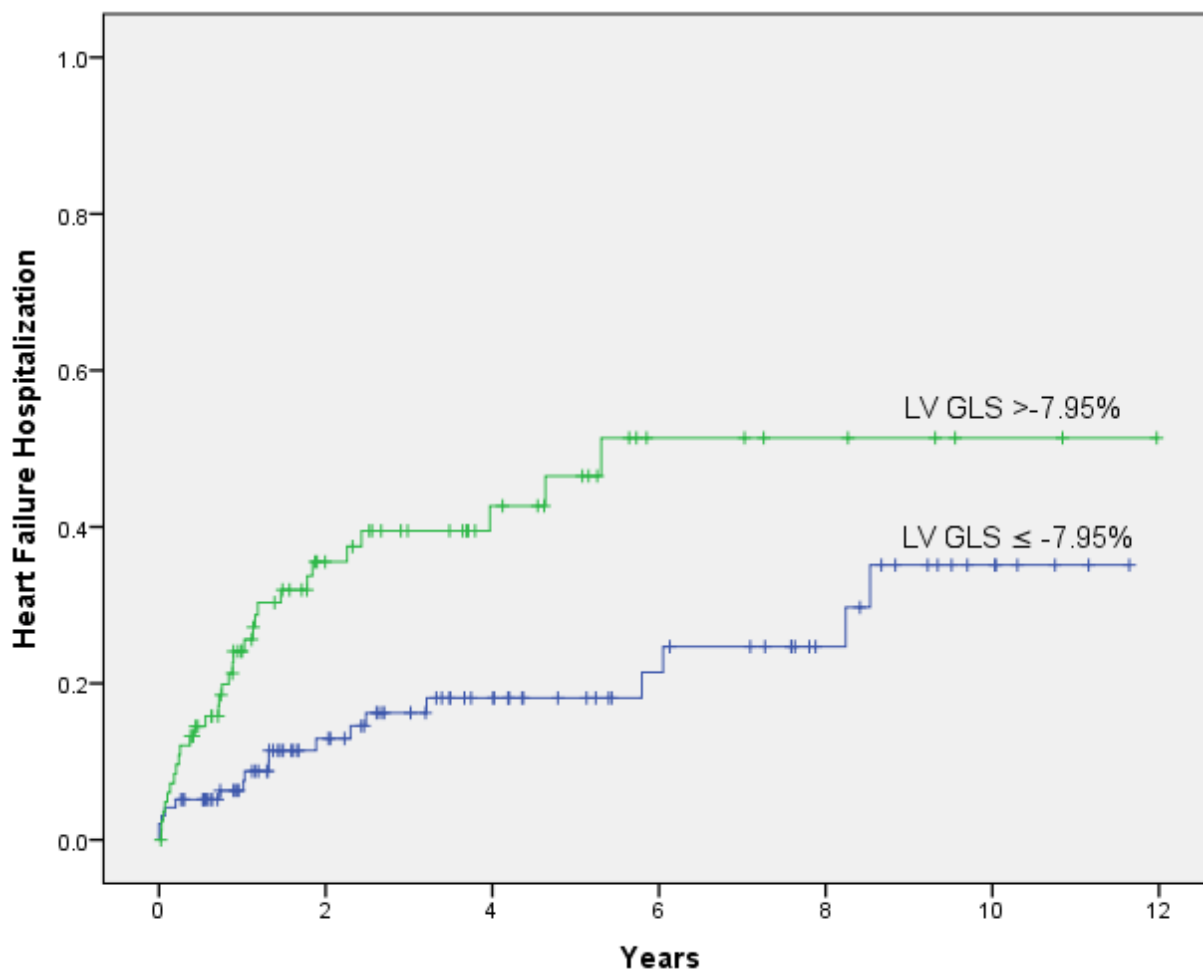


Figure 2. Kaplan-Meier curves of heart failure admissions for patients stratified by their left ventricular global longitudinal strain (LV GLS) $> -7.95\%$ vs. $\leq -7.95\%$. Log-rank $p=0.001$.

Controlling for age, sex, NYHA class, history of ischemic heart disease, atrial fibrillation/flutter, CKD, LVEF, and use of loop diuretics, GLS $> -7.95\%$ was found to be significant predictor of HF admissions (HR 3.86; 95% CI 1.38-10.77; $p=0.010$) (TABLE IV). The continuous GLS variable was not significantly associated with HF admissions after incorporating age, sex, NYHA class, history of ischemic heart disease, atrial fibrillation/flutter, CKD, and use of loop of diuretics (HR 1.05; 95% CI 0.98-1.13; $p=0.193$) (TABLE IV).

TABLE IV. MULTIVARIATE COX REGRESSION HAZARD ANALYSIS FOR PREDICTION OF HF ADMISSION

Variable	HF Admission		
	Hazard ratio	95% CI	p-value
LV GLS >- 7.95%	3.86	1.38- 10.77	0.010
LVEF	1.03	0.99-1.07	0.190
Age	1.01	0.98- 1.04	0.497
Male	1.12	0.59-2.13	0.739
NYHA functional class II	2.02	0.79- 5.16	0.143
NYHA functional class III	2.60	1.05- 6.40	0.038
Ischemic heart disease	1.20	0.60-2.407	0.603
Atrial fibrillation/flutter	1.00	0.48-2.10	0.998
Chronic kidney disease	1.67	0.80-3.49	0.175
Loop Diuretics	1.06	0.42-2.69	0.904

LVEF, left ventricular ejection fraction; NYHA, New York Heart Assn;
LV GLS, left ventricular global longitudinal strain

V. DISCUSSION

In the present study, we demonstrated the value of LV GLS in predicting all-cause mortality and HF admission in AA patients with chronic HF. This is the first study, to our knowledge, to demonstrate the prognostic value of the LV GLS in AA with heart failure. It is also the first study to assess the prognostic value of LV GLS in patients on GDMT. Our data demonstrated that a LV GLS value of $> -7.95\%$ is a strong and an independent predictor of long-term all-cause mortality, and HF admissions in this patient cohort. We chose to study patients who were on GDMT in order to determine the prognostic value of LV GLS while controlling for differences that may occur secondary to titration of HF therapeutics.

Clinical characteristics of our AA patients were different from those investigated in the previous LV GLS studies.^{14, 15} Our study population included higher proportion of females and higher prevalence of hypertension, and did not include any patients with Class IV NYHA HF. The higher prevalence of HTN in AA compared to European Americans is expected, as it has been shown in previous studies.¹⁰

We demonstrated that LV GLS is a strong and independent predictor of all-cause mortality and HF admission after adjusting for factors that were thought to affect clinical outcomes. In contrast to previous studies that looked at composite outcomes,^{13, 16} we evaluated the prediction of all-cause mortality and HF admission separately. Our study also demonstrated that worse LV GLS as a continuous variable is a strong and independent predictor of all-cause mortality, with a trend to predict HF admission after adjusting for factors that were thought to affect clinical outcomes. These findings are supported by the fact that Motoki et.al. combined HF admission with all-cause mortality and cardiac transplantation as a composite outcome¹⁶ and that GLS predicted the composite outcome of all-cause mortality, cardiac

transplantation or ventricular assist device placement in a fully adjusted model, but failed to do so when LVEF was added to the model in a study by Zhang et. al.¹³

In our study we used a threshold of -7.95%, which corresponds to less impaired LV mechanics compared to the previous studies that used -6.95%²¹ and tertiles divided at -6.5% and -9.6%²³. The optimal threshold with less impaired LV GLS might be explained by the fact that we did not include any NYHA class IV HF in our population as compared to these other studies.

These results suggest the usefulness of the LV GLS as a risk stratifier for all-cause mortality and HF-admission in AA patients with HF. Whether patients identified as high risk would benefit from more aggressive medical therapy or closer clinical follow-up is still to be investigated.

VI. STUDY LIMITATION

Echocardiograms were not performed at the time of enrollment as patients were enrolled from the cardiology clinic and not from the echocardiography lab. We decided to use the date of echocardiogram as the day zero in the follow-up process to reflect the true follow-up period from the day LV GLS was measured. We also collected data from UI-Health electronic medical records. Whether patients had outcomes in other institutions that were not reported by the patient in our records is not known.

VII. CONCLUSION

In AA patients with chronic stable HF on GDMT, more impaired LV GLS ($>-7.95\%$) is a strong and independent predictor of long-term all-cause mortality and HF admission, superior to left ventricular ejection fraction and other known clinical risk predictors.

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12. Selvaraj S, Aguilar FG, Martinez EE, Beussink L, Kim KY, Peng J, Rasmussen-Torvik L, Sha J, Irvin MR, Gu CC, Lewis CE, Hunt SC, Arnett DK, Shah SJ. - Association of comorbidity burden with abnormal cardiac mechanics: Findings from the HyperGEN Study. - *J Am Heart Assoc*. 2014 Apr 29;3(3):e000631. doi: 10.1161/JAHA.113.000631.: - e000631.
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14. Li X, Jones M, Wang HF, Davies CH, Swanson JC, Hashimoto I, Rusk RA, Schindera ST, Barber BJ, Sahn DJ. - Strain rate acceleration yields a better index for evaluating left ventricular contractile function as compared with tissue velocity acceleration during isovolumic contraction time: an in vivo study. - *J Am Soc Echocardiogr*. 2003 Dec;16(12):1211-6.
15. Iacoviello M, Puzzovivo A, Guida P, Forleo C, Monitillo F, Catanzaro R, Lattarulo MS, Antoncicchi V, Favale S. - Independent role of left ventricular global longitudinal strain in predicting prognosis of chronic heart failure patients. - *Echocardiography*. 2013 Aug;30(7):803-11. doi: 10.1111/echo.12142. Epub 2013 Mar. - 803-811.
16. Motoki H, Borowski AG, Shrestha K, Troughton RW, Tang WH, Thomas JD, Klein AL. - Incremental prognostic value of assessing left ventricular myocardial mechanics in patients with chronic systolic heart failure. - *J Am Coll Cardiol*. 2012 Nov 13;60(20):2074-81. doi: 10.1016/j.jacc.2012.07.047.: - 2074-2081.

VITA

NAME: Ibrahim N. Mansour

EDUCATION: Cardiology Clinical Scientist Fellow, University of Illinois at Chicago,
7/2012-6/2016

Masters in Clinical and Translational Sciences, University of Illinois at Chicago,
12/2015

Residency in Internal Medicine from Southern Illinois University ,
06/2004-06/2007

Doctor of Medicine, Hacettepe University, Ankara, Turkey, 09/1994-06/2001

PROFESSIONAL EXPERIENCE:

University of Illinois at Chicago, Department of Medicine, Division of
Cardiology, Cardiology Clinician-Scientist Fellow, Chicago, IL, 07/2012-Present

Oscar G. Johnson VA Medical Center, Emergency Department Physician, Iron
Mountain, MI, 07/2012-Present

Fayette County Hospital, Emergency Department Physician, Vandalia, Il,
11/2013-Present

Advocate Christ Medical Center, House Physician, Oak Lawn, Il, 04/2013-
12/2014

Jesse Brown VA Medical Center, Emergency Department Physician, Chicago, Il
07/2012-03/2014

Dickenson County Health System Hospital, Hospitalist, Iron Mountain, MI,
08/2009-06/2011

Swedish American Hospital, Hospitalist, Rockford, Il, 04/2008-07/2009

Loretto Hospital, House-Physician, Chicago, Il, 06/2007-07/2008

Passavant Area Hospital, Emergency Department Physician, Jacksonville, Il,
01/2007-11/2012

Memorial Hospital of Carbondale, Emergency Department Physician,
Carbondale, Il, 02/2008-01/2009

Paris Community Hospital, Emergency Department Physician/Hospitalist, Paris,
Il, 02/2008-11/2012

Southern Illinios University, Internal Medicine Resident, Springfield, Il,
06/2004-06/2007

Hacettepe University Hospitals, Medical Intern, Ankara, Turkey, 07/2000-06/2001

RESEARCH
EXPERIENCE:

University of Illinois at Chicago, Department of Medicine, Division of Cardiology, Chicago, Il, 07/2012-Present

- Determinants of Cardiac Fibrosis and Spironolactone Response in Heart Failure
- Left ventricular speckle tracking strain analysis predicts mortality and morbidity in patients with heart failure
- Predictors of 30-day readmission for heart failure in a more economically disadvantaged and racially diverse population

University of Chicago Hospitals, Department of Medicine, Section of Cardiology Research Fellow, 06/2007-07/2013

- Use of a Web-Based Tool for Application of the ACCF/ASE Appropriateness Criteria for Transthoracic Echocardiography: A Pilot Study
- Comparison of the Updated 2010 Appropriate Use Criteria for Echocardiography to the Original Criteria for Transthoracic, Transesophageal, and Stress Echocardiography
- Prospective Evaluation of the Clinical Application of the ACCF/ASE Appropriateness Criteria for Stress Echocardiography
- Prospective Evaluation of the Clinical Application of the ACCF/ASE Appropriateness Criteria for Transesophageal Echocardiography
- Prospective Evaluation of the Clinical Application of the ACCF/ASE Appropriateness Criteria for Transthoracic Echocardiography

John H. Stroger Jr. Hospital of Cook County, University of Illinois at Chicago Medical Center, Department of Cardiology, Research Assistant/Volunteer, Chicago, Il, 09/2003-12/2007

- Outcomes in African American Patients with Heart Failure, Mortality, Readmission and Functional Decline
- Ability of CA-125, BNP and C-reactive protein to predict hospital readmission and cardiovascular events in patients

Southern Illinois University School of Medicine, Department of Endocrinology, Metabolism, and Molecular Medicine, Internal Medicine Resident, Springfield, Il, 07/2006-12/2007

- Continuous glucose monitoring system and blood pressure monitoring in healthy and Type 2 diabetic males
- Effects of fasting insulin level, fasting free fatty acids and body composition (measured by DEXA scan) on blood pressure

Rush-Presbyterian-St. Luke's Medical Center, Department of Orthopedic Surgery and Immunology, Research Assistant/Volunteer, Chicago, Il, 05/2003-06/2004

- Role of Cbl-b in T- and B-cell activation and Signaling Pathways.

Hacettepe University Hospitals, Medical Intern Department of Public Health, Ankara, Turkey, 07/2000-08/2000

- Researched and studied the rural population's level of satisfaction with the facilities provided by their village primary care center in Ankara, Turkey

Southern Illinois University, School of Medicine, Department of Internal Medicine Resident Physician, Springfield, IL, 08/2005-06/2007

- Value of newly added second-day continuity clinic
- Improving diabetes care using the components of a chronic care model in a panel of residents' patients with an established diagnosis of diabetes mellitus

PUBLICATIONS:

1. Ibrahim N. Mansour, Rabia R. Razi, Nicole M. Bhav, R. Parker Ward. Comparison of the updated 2011 appropriate use criteria for echocardiography to the original criteria for transthoracic, transesophageal, and stress echocardiography. *Journal of The American Society of Echocardiography*, November 2012; 25(11):1153-61. Section of Cardiology, Department of Medicine University of Chicago Hospitals, Chicago, IL.
2. Ibrahim N. Mansour, MD, Roberto M. Lang, MD, Waseem M. Aburuwaida, Nicole M. Bhav, MD, Parker R. Ward, MD. Evaluation of the clinical application of the ACCF/ASE appropriateness criteria for stress echocardiography. *Journal of the American Society of Echocardiography*, November 2010; 23(11):1199-204. Section of Cardiology, Department of Medicine University of Chicago Hospitals, Chicago, IL.
3. Ibrahim N. Mansour¹, Sirikarn Napan², M. Tarek Alahdab², Thomas D. Stamos. Elevated CA-125 Levels Predicts Long-Term Mortality in African American Patients Admitted With Acute Decompensated Heart Failure. *Journal of Congestive Heart Failure*, Jan-Feb. 2010; 16(1):15-20. 1Southern Illinois University, Springfield, IL, 2John H. Stroger Hospital of Cook County, 3The University of Illinois at Chicago, Chicago, IL.
4. R. Parker Ward MD, FASE, Daniel Krauss, MD, Ibrahim N. Mansour MD, Nicole Lemieux MD, Nitin Gera MD, Roberto M. Lang MD. Comparison of the Clinical Application of the ACCF/ASE Appropriateness Criteria for Outpatient Transthoracic Echocardiography in Academic and Community Practice Settings. *Journal of The American Society of Echocardiography*, September, 17, 2009. Section of Cardiology, Department of Medicine University of Chicago Hospitals, Chicago, IL and Illinois Heart and Vascular, Hinsdale, Illinois.
5. Ibrahim N. Mansour, Kathy Furlong, Anne Ryan, Roberto M. Lang, R. Parker Ward. Prospective Evaluation of the Clinical Application of the ACCF/ASE Appropriateness Criteria for Transesophageal Echocardiography. *Journal of The American Society of Echocardiography*

May 2009;22(5):517-22. Section of Cardiology, Department of Medicine University of Chicago Hospitals, Chicago, IL.

6. M. Tarek Alahdab, M.D.1; Ibrahim N Mansour, M.D.2; Sirikarn Napan, M.D.1; Thomas D. Stamos, M.D.3. Six Minute Walk Test Predicts Long-Term All-Cause Mortality and Heart Failure rehospitalization in African American Patients Hospitalized with Acute Decompensated Heart Failure. *Journal of Cardiac Failure*, March 2009;15(2):130-5, 1 John H. Stroger Hospital of Cook County, 2 Southern Illinois University, Springfield, IL, 3 The University of Illinois at Chicago, Chicago, IL.
7. R. Parker Ward, MD, FACC, Ibrahim N. Mansour, MD, Nicole Lemieux, MD, Nitin Gera, MD, Rupa Mehta, MD, Roberto M. Lang, MD, FACC. Prospective Evaluation of the Clinical Application of the American College of Cardiology Foundation/American Society of Echocardiography Appropriateness Criteria for Transthoracic Echocardiography. *Journal of American College of Cardiology, Cardiovascular imaging*, september 2008; 1:663-671. Section of Cardiology, Department of Medicine University of Chicago Hospitals, Chicago, IL.
8. Issa Ziad, Mansour Ibrahim N. Diagnostic Value of ICD Antitachycardia Pacing Therapy; *The Journal of Cardiovascular Electrophysiology*. Vol. 18, pp.548-549, May 2007. Arrhythmia Rounds. Prairie Heart Institute and Southern Illinois University, Springfield, IL.
9. Bress A, Han J, Patel SR, Desai AA, Mansour I, Groo V, Progar K, Shah E, Stamos TD, Wing C, Garcia JG, Kittles R, Cavallari LH. Association of aldosterone synthase polymorphism (CYP11B2 -344T>C) and genetic ancestry with atrial fibrillation and serum aldosterone in African Americans with heart failure. *PLoS One*. 2013 Jul 30. Section of Cardiology, Department of Medicine, University of Illinois, Chicago, IL.

ORAL PRESENTATIONS/POSTER SESSIONS:

1. Simone Romano, Ibrahim N. Mansour, Mayank Kansal, Hana Gheith, Zachary Dowdy, Carolyn A. Dickens, Cassandra Buto-Colletti, June M. Chae, Thomas D. Stamos. Left Ventricular Global Longitudinal Strain Predicts Heart Failure Readmission in Acute Decompensated Heart Failure. Poster presentation at the American Society of Echocardiography, Annual Scientific Meeting, Boston, MA, June 12-16th, 2015. University of Verona, Department of internal medicine, Verona, Italy, University of Illinois at Chicago, Division of Cardiology, Chicago, IL.
2. Ibrahim N. Mansour, Mayank Kansal, Sahar Ismail, Omer Mirza, Adam Bress, Grace Wu, Larisa Cavallari, Thomas D. Stamos. Left Ventricular Global Longitudinal Strain Predicts Heart Failure Admissions in African American Patients. Poster presentation at the American Society of Echocardiography, Annual Scientific Meeting, Portland, OR, June 20-23rd, 2014. Division of Cardiology, University of Illinois at Chicago, Chicago, IL
3. Ibrahim N. Mansour, Mayank Kansal, Sahar Ismail, Vicki Groo, Shital Patel, Adam Bress, Rahul Marpadga, Larisa Cavallari, Thomas D. Stamos. Serum N-terminal Procollagen III Propeptide Correlates with Left Ventricular Global Longitudinal Strain in African Americans with Heart Failure. Poster presentation at the American Society of Echocardiography, Annual Scientific Meeting, Portland, OR, June 20-23rd, 2014. Division of Cardiology, University of Illinois at Chicago, Chicago, IL

4. Ibrahim N. Mansour, Sahar Ismail, Adam Bress, Vicki Groo, Shital Patel, Hana Heith, Thomas Stamos, Larisa Cavallari. Serum N-terminal Procollagen III Propeptide Predicts All-cause Mortality in African American patients with Heart Failure. Heart Failure Society of America, Annual Scientific Meeting, Las Vegas, NV, September 14-17th, 2014. Division of Cardiology, University of Illinois at Chicago, Chicago, IL
5. Ibrahim N. Mansour, Mayank Kansal, Sahar Ismail, Omer Mirza, Adam Bress, Grace Wu, Rahul Marpadga, Yien Li, Larisa Cavallari, Thomas Stamos. Left Ventricular Global Longitudinal Strain Predicts Mortality in African Americans with Heart Failure. Heart Failure Society of America, Annual Scientific Meeting, Las Vegas, NV, September 14-17th, 2014. Division of Cardiology, University of Illinois at Chicago, Chicago, IL
6. Ibrahim Mansour, MD, Hana Gheith, MD, Zachary Dowdy, MD, Carolyn Dickens, NP, Thomas Stamos, MD. Anemia predicts 30-Day Hospital Readmission for Heart Failure in African Americans. AHA Quality of Care and Outcomes Research Scientific Sessions 2014, June 2014, Washington, DC. Division of Cardiology, University of Illinois at Chicago, Chicago, IL.
7. Adam Bress,^a Shitalben Patel,^a Ankit A. Desai,^b Ibrahim Mansour,^b Vicki Groo,^{a,b} Jin Han,^a Kristin Progar,^a Ebony Shah,^c Thomas Stamos,^b Rick Kittles,^{c,d} and Larisa Cavallari,^a Association of Aldosterone Synthase Polymorphism (CYP11B2 -344T>C) with Atrial Fibrillation in African-Americans with Heart Failure. Clinical research abstract, poster presentation at the American College of Cardiology, 62nd annual scientific session in San Francisco, CA, March 9th-11th, 2013. ^aDepartment of Pharmacy Practice; ^bDepartment of Medicine, Section of Cardiology/Institute of Personalized Respiratory Medicine; ^cDepartment of Medicine; ^dDivision of Epidemiology and Biostatistics; University of Illinois at Chicago, Chicago, IL
8. R. Parker Ward, Ibrahim N. Mansour, Nicole M. Bhave, Federico Veronesi, Roberto M. Lang. Use of an On-Line Web Based Tool for the Application of Appropriate Use Criteria for Transthoracic Echocardiography: A Pilot Study. Clinical research abstract, poster presentation at the American Society of Echocardiography, annual scientific session, San Diego, California. June 12th-15th, 2010. Section of Cardiology, Department of Medicine University of Chicago Hospitals, Chicago, IL.
9. Ibrahim N. Mansour, Waseem M Aburuwaida, Roberto M. Lang, R. Parker Ward. Prospective Evaluation of the Clinical Application of the ACCF/ASE Appropriateness Criteria for Stress Echocardiography. Oral presentation at the American Heart Association, annual scientific session, Orlando, Florida. November 14th-18th, 2009. Section of Cardiology, Department of Medicine University of Chicago Hospitals, Chicago, IL.
10. M. Tarek Alahdab, M.D.1; Ibrahim N Mansour, M.D.2; Sirikarn Napan, M.D.1; Thomas D. Stamos, M.D.3. Six Minute Walk Test Predicts Long-Term All-Cause Mortality and Heart Failure rehospitalization in African American Patients Hospitalized with Acute Decompensated Heart Failure. Clinical research abstract, oral presentation at the American Heart Association, annual scientific session, New Orleans, Louisiana. November 7th-11th, 2008. 1 John H. Stroger Hospital of Cook County, 2 Southern Illinois University, Springfield, IL, 3 The University of Illinois at Chicago, Chicago, IL.

11. Ibrahim N. Mansour, Kathy Furlong, Anne Ryan, Roberto M. Lang, R. Parker Ward. Prospective Evaluation of the Clinical Application of the ACCF/ASE Appropriateness Criteria for Transesophageal Echocardiography. Clinical research abstract, poster presentation at the American Society of Echocardiography, annual scientific session, Toronto, Canada. June 7th-11th, 2008. Section of Cardiology, Department of Medicine University of Chicago Hospitals, Chicago, IL.
12. Ibrahim N. Mansour¹, M. Tarek Alahdab², Sirikarn Napan², Russell F. Kelly², Thomas D. Stamos. Elevated CA-125 Levels Predicts Long-Term Mortality in African American Patients Admitted With Acute Decompensated Heart Failure. Clinical research abstract, oral presentation at the American College of Physicians, Internal Medicine 2008, Annual National scientific meeting, Washington, DC. May 15th-17th. 2008 , 1Southern Illinois University, Springfield, IL, 2John H. Stroger Hospital of Cook County, 3The University of Illinois at Chicago, Chicago, IL.
13. R. Parker Ward, Nicole Lemieux, Nitin Gera, Ibrahim Mansour N., Rupa Mehta, Roberto Lang M. Prospective Evaluation of the Clinical Application of the ACCF/ASE Appropriateness Criteria for Transthoracic Echocardiography. Clinical research abstract, oral presentation at the American College of Cardiology, 57th annual scientific session in Chicago, IL, March 29th-April 1st, 2008 Section of Cardiology, Department of Medicine University of Chicago Hospitals, Chicago, IL.
14. Ibrahim N.Mansour, M. TarekAlahdab, MartinReriani, Thomas D.Stamos.The Kansas City Cardiomyopathy Questionnaire Predicts Hospital Readmission in African American Patients with Acute Decompensated Heart Failure. SIU-SOM Annual Research Trainee Symposium, April 25th 2007. Clinical research abstract, oral presentation. John H. Stroger, Jr. Hospital of Cook County, University of Illinois at Chicago Medical Center and Southern Illinois University, Springfield, IL.
15. Ibrahim N.Mansour, SyedGilani, AlanDeckard, StuartTorgerson, MohammedParvez and RaymondFarrell Abdominal Pain (Chronic Mesenteric Ischemia). ACP Downstate Associate Meeting. October, 2006. Oral presentation. Case report. Southern Illinois University, Springfield, IL.
16. Ibrahim N.Mansour, N.Nallamotheu, AlanDeckard. Cardiac metastasis from a transitional cell carcinoma.Case report. Poster presentation at the ACP Illinois Chapter meeting at Peoria IL, October, 2006. Prairie Heart Institute and Southern Illinois University, Springfield, IL.
17. Thomas D.Stamos, M. Tarek Alahdab, Ibrahim N. Mansour. Right Ventricular Tissue Doppler is Associated with Functional Capacity in Heart Failure Patients; Clinical research abstract, poster presentation at the Annual scientific session of the Heart Failure Society of America in Boca Raton, Florida. September 18th-21st 2005. John H. Stroger, Jr. Hospital of Cook County, University of Illinois at Chicago Medical Center.

AWARDS/

NOMINATIONS: American College of Cardiology, Illinois Chapter ACC Fellow-in-Training research Symposium second best poster presentation award. Chicago, IL, February 20th, 2013.

American College of Physicians and Merck U.S. Human Health 2008 Associate Research Competition Award Winner. The research abstract titled “Elevated CA-125 Levels Predicts Long-Term Mortality in African American Patients Admitted With Acute Decompensated Heart Failure” was one of ten selected from approximately 2,000 abstracts.

Nominated for Resident of the Year during my first and second year of residency for my teaching abilities.

I set a record on my medical school placement exam in Turkey, which gained me acceptance into the number one ranked medical school in the country.