March, 2019

# Gender Differences in Takotsubo Cardiomyopathy as a Secondary Diagnosis: Higher Hospital Charges, More Procedures, and Longer Length of Stays

Daniel Eric Westerdahl
Hsin-Fang Li
Amir Yazdani
Kateri Spinelli
Tyler Gluckman

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Daniel E. Westerdahl, MD, Hsin-Fang Li, PhD, Amir Yazdani, Kateri J. Spinelli, PhD, Ty J. Gluckman, MD
Center for Cardiovascular Analytics, Research and Data Science (CARDS), Providence Heart Institute, Providence St. Joseph Health, Portland, OR

## Background

- The incidence of Takotsubo Cardiomyopathy (TC) has risen steadily over the past decade, with current estimates in the U.S. of 15-30 cases per 100,000 per year[1]
- It has been previously reported that men diagnosed with TC have worse outcomes[2,3]
- The relationship between gender-related differences in total hospital charges, number of procedures performed, and length of stay (LOS) among cases where TC is a secondary diagnosis have not been previously reported

## Hypothesis

- Underrecognition of TC in men leads to increased procedures, higher hospital charges, longer length of stay, and worse outcomes

## Methods

- Retrospective cohort study using National Inpatient Sample (NIS) data from 2009-2016
- Inclusion criteria: Hospitalizations in those ≥18 years who underwent diagnostic coronary angiography (CCS 47), with a secondary diagnosis of TC (ICD 9 code 429.83; ICD 10 code I51.81)
- Exclusion criteria: Diagnostic angiography that was followed by percutaneous or surgical coronary revascularization (CCS 44 or 45)
- Demographics, comorbidities and outcomes including hospital mortality, total charges, and LOS were assessed and stratified by gender
- Continuous variables were described using means and compared using independent two-sample t-tests; total charges and LOS were described using medians and compared using Wilcoxon rank sum test
- TC encounters were propensity matched by age, number of chronic conditions, number of procedures performed, and severity of illness within each year and combined for the analysis
- A discharge weight was included in all analyses to account for the complex sample design of the NIS

**Table 1: Demographics and comorbidities**

| Variable | Male | Female |
|---|---|---|
| Unadjusted N | 1786 (14%) | 11,204 (86%) |
| Weighted N | 8814 ± 216 | 55,163 ± 598 |
| Age >65 yrs, % ± SE | 48.2 ± 1.2 | 61.4 ± 0.4 |
| Age, yrs | 62.6 ± 0.3 | 67.6 ± 0.1 |
| In-hospital death, % ± SE | 5.0 ± 0.5 | 3.2 ± 0.2 |
| # procedures | 5.25 ± 0.09 | 4.47 ± 0.03 |
| # chronic conditions* | 8.18 ± 0.08 | 8.09 ± 0.04 |
| Severity** | 2.95 ± 0.02 | 2.68 ± 0.01 |
| LOS, median (IQR) | 4.2 (2.0, 8.6) | 3.6 (1.8, 6.8) |
| Total charges, median (IQR) | $56,851 (33552, 113473) | $46,617 (29363, 83092) |
| **Comorbidities*, %** | | |
| Alcohol abuse | **13.2%** | **3.4%** |
| Congestive heart failure | 18.8% | 15.9% |
| Chronic pulmonary disease | 31.7% | 31.0% |
| Depression | **10.7%** | **17.5%** |
| Diabetes, uncomplicated | 18.9% | 20.3% |
| Diabetes with chronic complications | 3.7% | 3.0% |
| Drug abuse | **7.5%** | **4.5%** |
| Hypertension | 62.8% | 66.4% |
| Hypothyroidism | **6.4%** | **20.1%** |
| Obesity | 9.6% | 12.0% |
| Renal failure | 10.9% | 9.4% |

Data presented as n (%) or mean ± SE, unless otherwise indicated
p<.0001 for all comparisons; bolded comorbidities had the largest between-gender differences
* Number of chronic conditions and comorbidity information not available within the NIS data set for Q4-2015 and 2016
** Severity of illness subclass within each base APR DRG, scale 0-4 (0=no class specified, 1=minor loss of function, 2=moderate loss of function, 3=major loss of function, 4=extreme loss of function)

## Results

- Between 2009 and 2016, 1,786 men and 11,204 women had encounters with TC as a secondary diagnosis; this corresponds to a national estimate of 8,814 men and 55,163 women
- The number of procedures performed, in-hospital death rate, hospital charges, and LOS were higher for men; the average age was higher for women (Table 1)
- Men had higher rates of alcohol and drug abuse; women had higher rates of depression and hypothyroidism (Table 1)
- Total charges increased over time for both men and women, while number of procedures, LOS, and severity remained largely flat (Figure 1)
- Procedures performed most commonly were similar between men and women; however, they were performed earlier in the hospitalization for women (Table 2)

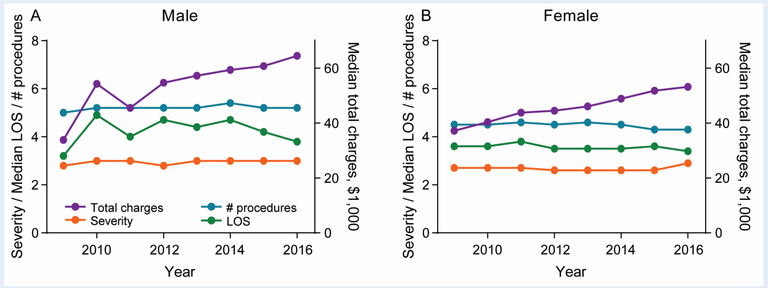


**Figure 1 – Gender differences in secondary TC.** For both men (A) and women (B), there was an increase in total charges over time. LOS, number of procedures, and total charges were overall higher for men compared to women.

**Table 2: Top 10 procedure classifications* by gender**

| Male | % | Proc. Day | Female | % | Proc. Day |
|---|---|---|---|---|---|
| Coronary arteriography | 100.0 | 2.3 | Coronary arteriography | 100.0 | 1.8 |
| Respiratory intubation and mechanical ventilation | 29.2 | 1.4 | Respiratory intubation and mechanical ventilation | 19.9 | 1.3 |
| Insert endotracheal tube** | 19.3 | 1.8 | Insert endotracheal tube** | 12.0 | 1.5 |
| Cont mech vent < 96 hrs** | 16.9 | 1.1 | Cont mech vent < 96 hrs** | 11.1 | 1.0 |
| Other vascular catheterization; not heart | 20.9 | 2.8 | Other vascular catheterization; not heart | 14.4 | 2.6 |
| Other therapeutic procedures | 9.9 | 1.7 | Diagnostic ultrasound of heart (echocardiogram) | 9.0 | 1.7 |
| Diagnostic ultrasound of heart (echocardiogram) | 9.1 | 1.7 | Other therapeutic procedures | 6.4 | 1.5 |
| Blood transfusion | 7.3 | 6.1 | Blood transfusion | 6.2 | 4.3 |
| Contrast aortogram | 6.0 | 2.3 | Contrast arteriogram of femoral and lower extremity arteries | 4.9 | 2.1 |
| Conversion of cardiac rhythm | 5.7 | 2.9 | Contrast aortogram | 4.4 | 1.6 |
| Contrast arteriogram of femoral and lower extremity arteries | 4.9 | 2.1 | Upper GI endoscopy; biopsy | 3.4 | 5.2 |
| Other OR heart procedures | 4.4 | 3.3 | Conversion of cardiac rhythm | 3.2 | 2.6 |

* Based on 231 procedure categories from PRCCCS clinical classification software.
** Individual procedure codes
Proc. Day = number of days from admission to procedure, with admission = day 0

## Results (Continued)

- Applying propensity matching for age and the number of procedures performed (Model 4), the difference in median total charges between men and women decreased to $1,658, the difference in LOS decreased to 0.3 days, and the difference in mortality decreased to 1.3% (Figure 2 and Table 3)

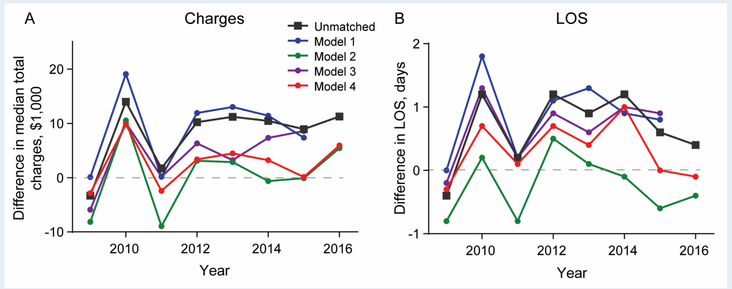


**Figure 2 – Propensity-matched models:** Difference in median charges (A) and median LOS (B) between males and females, unmatched and propensity-matched by four separate models. Matching variables for each model provided in Table 3.

**Table 3: Outcomes before and after propensity matching**

| | Unmatched | | Model 1 (age, # chronic conditions) | | Model 2 (age, severity) | | Model 3 (age, # chronic conditions, # procedures) | | Model 4 (age, # procedures) | |
|---|---|---|---|---|---|---|---|---|---|---|
| Variable | Male | Female | Male | Female | Male | Female | Male | Female | Male | Female |
| Age, years | 62.3 | 67.6 | 62.3 | 63.8 | 62.3 | 63.4 | 62.3 | 63.5 | 62.3 | 62.7 |
| # chronic conditions* | 8.2 | 8.1 | 8.2 | 8.1 | 8.2 | 8.4 | 8.2 | 8.0 | 8.2 | 8.2 |
| Severity** | 2.9 | 2.6 | 2.9 | 2.6 | 2.9 | 3.0 | 2.9 | 2.7 | 2.9 | 2.8 |
| In-hospital death, % | 5.5 | 3.3 | 5.5 | 2.2 | 5.5 | 3.7 | 5.5 | 3.7 | 5.5 | 4.2 |
| # procedures | 5.2 | 4.5 | 5.2 | 4.5 | 5.2 | 5.0 | 5.2 | 5.0 | 5.2 | 5.2 |
| LOS, median | 4.3 | 3.6 | 4.3 | 3.5 | 4.3 | 4.6 | 4.3 | 3.6 | 4.3 | 4.0 |
| Total charges, median | 54,655 | 45,455 | 54,655 | 43,987 | 54,655 | 54,248 | 54,655 | 48,187 | 54,655 | 52,997 |
| Diff. in charges | +9,200 | | +10,668 | | +407 | | +6,468 | | +1,658 | |
| Diff. in LOS | +0.7 | | +0.8 | | -0.3 | | +0.7 | | +0.3 | |

* Number of chronic conditions not available within the NIS data set for Q4-2015 and 2016
** Severity of illness subclass within each base APR DRG, scale 0-4 (0=no class specified, 1=minor loss of function, 2=moderate loss of function, 3=major loss of function, 4=extreme loss of function)

## Conclusions

- Compared to women with a secondary diagnosis of TC, men are more likely to have a greater number of procedures, a longer length of stay and ~$9,000 more in hospital charges. These differences decreased, however, after propensity matching for age and number of procedures.
- For the top 10 procedures in this cohort, men had them performed later into the hospitalization
- Greater awareness of TC as a potential secondary diagnosis is warranted, particularly among men

References: 1. Medina de Chazal H et al. Stress cardiomyopathy diagnosis and treatment. (2018) *J Am Coll Cardiol.* 2. Khera R et al. Trends in hospitalization for takotsubo cardiomyopathy in the US. (2016) *Am Heart J.* 3. Lemor A et al. Impact of gender on in-hospital outcomes in patients with Takotsubo syndrome. (2018) *Clinical Cardiol.*

Contact info: Kateri.Spinelli@providence.org, Daniel.Westerdahl@providence.org
Acknowledgements and funding: None
Disclosures: None