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Case Report Open Access

Takotsubo Cardiomyopathy a Case Report: Ballooning outside the Apex?

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Abstract

Takotsubo's cardiomyopathy is characterized as per Mayo criteria by transient wall motion abnormalities involving the left ventricular apex and mid-ventricle in the absence of obstructive epicardial coronary artery disease and pheochromocytoma or myocarditis as well as new electrocardiographic abnormalities. Recent literature has suggested a variance in segments involved in this stress induced cardiomyopathy. This case illustrates not only classic left apical and mid-ventricular involvement but also a reduction in basal contractility (compared to normal strain numbers by segment) as measured by strain.

Keywords: Takotsubo's cardiomyopathy; Stress cardiomyopathy; Strain

Introduction

The recognition of Takotsubo's cardiomyopathy (TCM) has been increasing worldwide [1]. To date there have been many descriptive studies of this disorder, but relatively few studies conclusively describe the mechanism underlying this dramatic illness. Further there are varying presentations of the Takotsubo's cardiomyopathy in the literature.

It is estimated that up to 2% of patients who present with an acute coronary syndrome suffer instead from Takotsubo's cardiomyopathy [2]. Some of the basic facts we have gleaned concerning this disorder is that it occurs primarily in post-menopausal women [3]. Second, there is usually a preceding emotional or physical stress: Sharkey, et al. noted that 89% of patients with SCM had some stress factors [4]. Finally the application of multiple imaging modalities has shown that there is a heterogeneity of phenotypes of Takotsubo's cardiomyopathy, with the apical ballooning (Takotsubo) being most commonly recognized.

However with increased awareness of this apical ballooning cardiomyopathy particularly in the perioperative period the diagnosis of Takotsubo's may in fact be increasing secondary to recognition of particular characteristics in presentation (ventricular tachycardia, apical ballooning, absence of ischemic heart disease, transiency in survivors, and a prior stressor) [5]. Current models suggest that apical myocardium has an enhanced response to high levels of catecholamines likely due to a variation in beta receptor subtypes with a preponderance of beta 1 receptors resulting in positive inotropy in the more basilar segments and a higher ratio of beta 2 subtypes resulting in negative inotropy in the apical segments [6]. Thus a high catecholamine inducing event could result in ballooning of myocardium with densely populated beta 2 receptors.

The purpose of the following case report is to highlight the use of contemporary advanced imaging techniques to diagnose regional myocardial dysfunction including strain analysis and its possible use in monitoring recovery. This case report also aims to document in the literature a perioperative cardiac event demonstrating variability in the segmental reduction of regional myocardial strain in Takotsubo cardiomyopathy.

Case Report

A 27 year old female, G2P2 (delivery 16 months prior), presented to the surgical suite with right upper quadrant pain due to cholelithiasis. Subsequently an elective laparoscopic cholecystectomy was scheduled. Preoperative cardiac assessment was negative for any cardiac symptomatology, and the patient, by history, had good functional capacity. After the patient was interviewed by the anesthesia care team, she began to cry inconsolably and stated she felt uneasy about general anesthesia and had a fatal premonition. The patient was counseled once again and given Midazolam 5 mg IV in divided doses. She also received Pepcid 20 mg IV for regurgitant prophylaxis. For the induction of anesthesia after preoxygenation, she received Lidocaine 50 mg IV, Fentanyl 100 mcg IV, Propofol 200 mg IV, and Rocuronium 50 mg IV. Her airway was intubated and vital signs stable throughout the course of surgery. The procedure lasted 81 minutes. She was given Neostigmine 3 mg and Glycopyrrolate 0.6 mg for reversal of neuromuscular blockade. After showing signs of complete reversal of neuromuscular blockade and meeting extubation criteria, the endotracheal tube was removed and she taken to PACU.

The patient was placed on standard ASA monitors in the PACU. Seconds later she developed ventricular tachycardia with profound hypotension. Her systolic blood pressure was 60 mmHg (Figure 1). Upon supportive therapy with oxygen she regained sinus rhythm but appeared weak. She also had difficulty following commands. A second dose of Neostigmine 2 mg and Glycopyrrolate 0.4 mg was given. She continued to appear weak while maintaining an SaO_2 of 87% to 92% while on 100% O_2. She was reintubated in PACU. Her systolic blood pressure subsequently dropped to 70-80 mmHg after regain a brief normal blood pressure and was accompanied by sinus tachycardia with a rate in the 120s. Her blood pressure was supported acutely with phenylephrine and crystalloid.

AnABG after intubation revealed: 7.275, 38.8, 73.1, 17.9 and -8.4. A 12 lead EKG showed T wave inversions in precordial leads V3-V6 (Figure 2). Her chest x-ray showed evidence of pulmonary edema. Transthoracic echocardiography revealed an LVEF of 15-20% with

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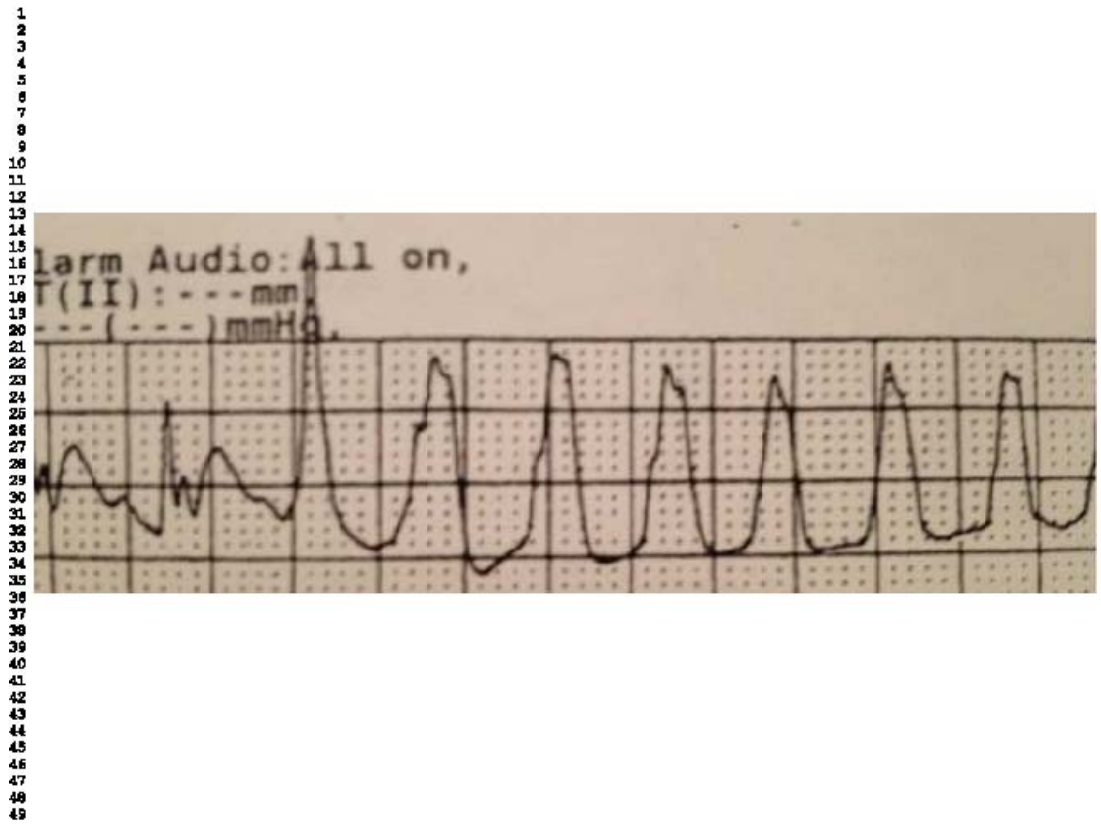

Figure 1: Initial V-tach arrest.

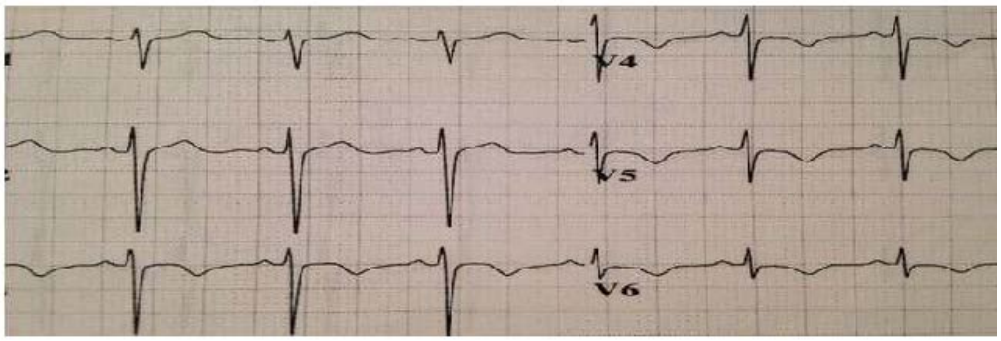

Figure 2: 12 lead EKG post arrest.

apical ballooning of the left ventricle consistent with a diagnosis of Takotsubo's cardiomyopathy (Figure 3).

After her course of supportive therapy in recovery, the patient was stabilized and admitted to the ICU, supported with dobutamine. Cardiac catheterization revealed clean coronaries. She also ruled out for myocardial infarction by three serial serium troponins. By day 3, her echocardiogram showed signs of recovery: EF improved to 35-40%; she was discharged to home the following day. A follow up echocardiogram performed 3 weeks later showed complete restoration of normal systolic function.

Discussion

The criteria necessary for diagnosis of SCM, (i.e. Takotsubo cardiomyopathy) include transient left ventricular apical ballooning with akinesis or dyskinesis, absence of obstructive coronary artery disease, new electrocardiographic abnormalities, and absences of concurrent conditions [7]. This cardiomyopathy is characterized traditionally by complete resolution of myocardial dysfunction, usually within 4 weeks from the inciting event [8]. The emotional stress experienced by this patient may have caused an endogenous discharge of noradrenaline and/or adrenaline in excess leading to catecholamine cardiotoxicity [9]. Current models suggest regional myocardial differences in response to high catecholamine levels whereby the base of left ventricle responds with positive isotropy and the apex with negative inotropic effects [6]. In this case, it remains unknown whether the LV response was due to basal load or a myocardial phenotype with a preponderance of beta 2 receptors throughout the ventricle.

Speckle tracking strain analysis performed using commercially available equipment is shown in figure 4. LAX longitudinal strain and apical ballooning (right) (Figure 5).

In this presentation not only is the GLS markedly reduced, but the 'unaffected' segments also have reduced strains. For a healthy young woman, a basal strain of 15 is reduced (Table 1). LV dysfunction is much more diffuse in this case than initially described by Wittstein (2008). Other variations of the classic form of apical ballooning have been described such as mid- or basal left ventricular wall motion abnormalities.

Strain analysis of the LV characterizes the regional myocardial kinetic differences and provides supportive evidence for the diagnosis of SCM. However the strain analysis in this case indicated much more extensive regional dysfunction than has been proposed by Wittstein and coworkers. While strain identifies the myocardium most sensitive to high circulating endogenous catecholamines, it also shows regional dysfunction in segments not generally thought to be injured by catecholamine stress. Whether these segments are dysfunctional because of load or because of tethering effects is not known. Certainly by virtue of the increase in load occasioned by significant LV dilation, there must be some afterload related LV dysfunction (Figure 6).

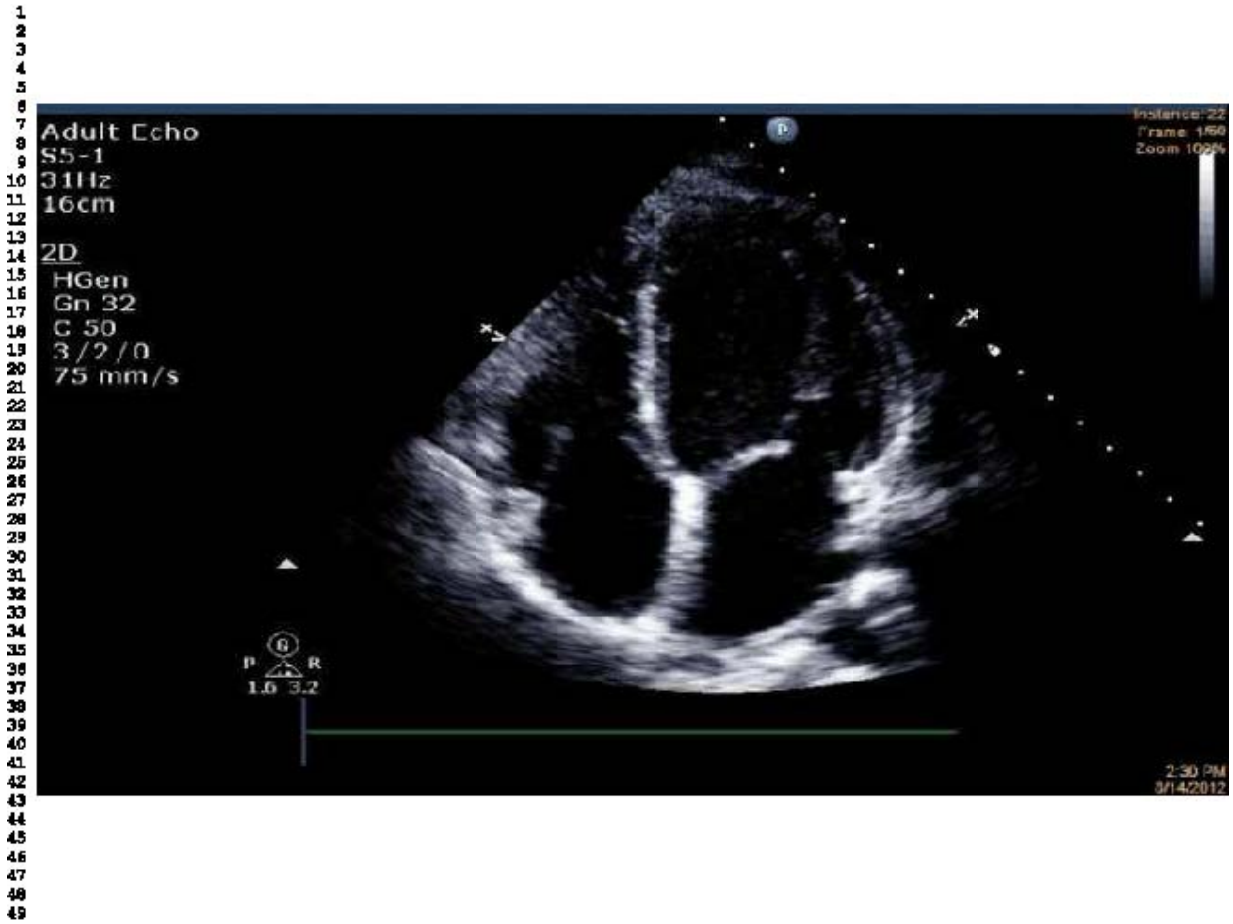

Figure 3: Left ventricular apical ballooning, shown on the apical 4 chamber view.

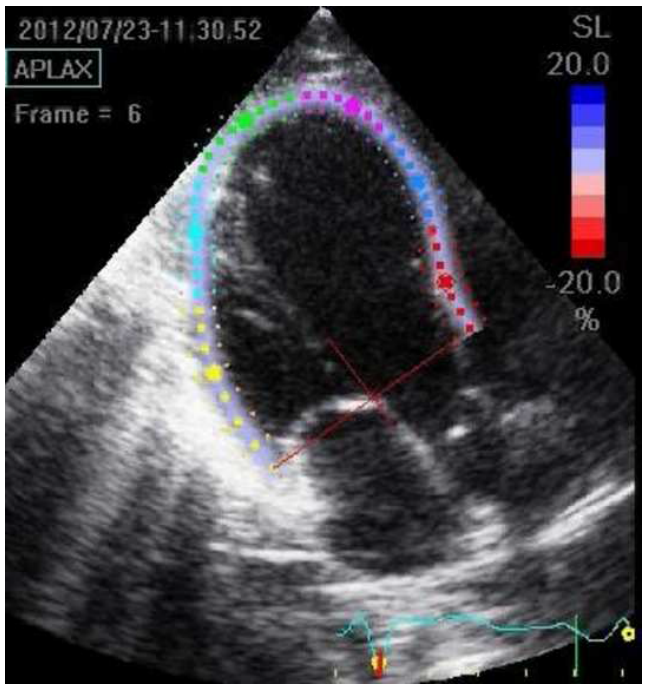

Figure 4: Speckle tracking strain analysis was performed using commercially available equipment is shown. LAX longitudinal strain and apical ballooning (right).

We believe that 2D strain consequently can play an essential role in tracking the regional myocardial recovery. Typical resolution of apical dyskinesis and resolution of symptoms to normal systolic function occurs within 4 weeks. Regional strain can once again be measured and if normal should define recovery as opposed to a normal ejection fraction alone. The normal values for longitudinal peak strain are -20% (± 2) [10]. Harwick describes strain values for all walls all levels at -18.6% (± 5.1) with the following regional strain values listed below [11]. Dalen et al. described normal GLS as -17.4% (± 2.3) in women and -15.9% (± 2.3) [12].

Current 3D and 4D strain analyses can further identify stress patterns in multiple dimensions simultaneously. Radial, circumferential, and longitudinal strain can be measured in all LV segments with a single acquisition providing a more aggressive analysis of regional myocardial function. Various 3D speckle tracking echocardiography approaches provide cardiologists the ability to estimate true 3D myocardial motion and deformation producing better views of regional myocardial mechanics [13]. This consequently allows identification of specific regional cardiac dysfunction which may be due to post stress hyper-catecholaminemia and a basis for tracking ventricular recovery. In fact longitudinal strain assessed by 3D speckle tracking is a predictor for segmental improvement after other causes of myocardial dysfunction such as acute MI [14].

Conclusion

In closing, this presentation of Takotsubo's cardiomyopathy demonstrates not only the classical apical strain reduction but additionally the reduction in strain in the mid-basal regions.

Strain analysis by speckle tracking is essential in diagnosis and guiding recovery in these patients. Consequently it is emerging as a mainstay in monitoring regional wall motion abnormalities in TCM. In the acute phase a cardiac anesthesiologist may find strain patterns useful in clinching a quick suspicion for Takotsubo's cardiomyopathy

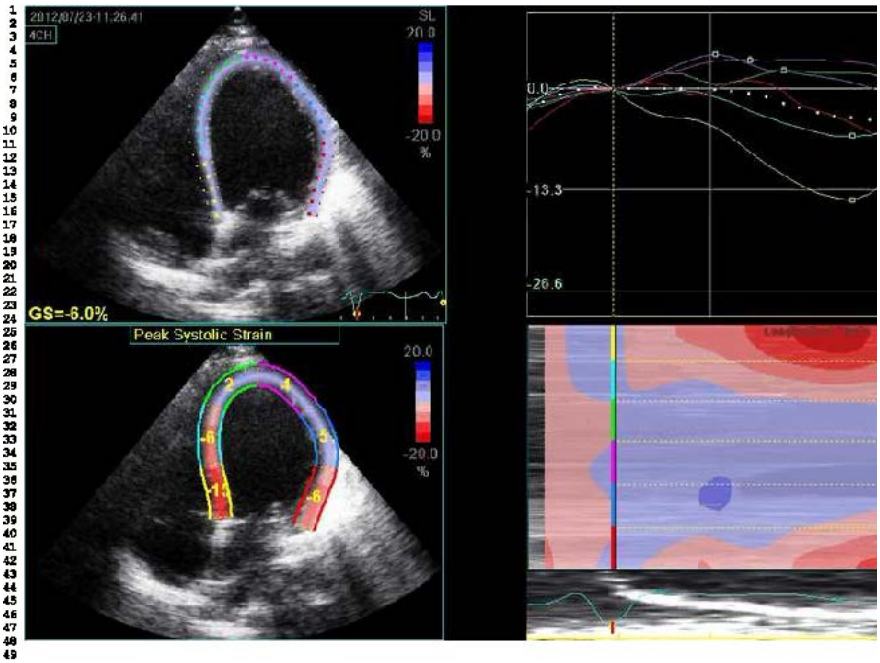

Figure 5: (Counterclockwise) a. Global strain remarkably impaired. b. Markedly reduced longitudinal strain in the left ventricular apex. c. Graph shows an M wave illustration indicating strain rate during systole. d. 6 segment strain wave through the cardiac cycle (with the basal inferior segment maintaining the best strain).

	All levels	Apical	Mid	Basal
All walls	-18.6% ± 5.1	-20.2% ± 5.6	-18.7% ± 3.8	-17.0% ± 5.2

Table 1: Cardiac segments in Takotsubo Cardiomyopathy [12].

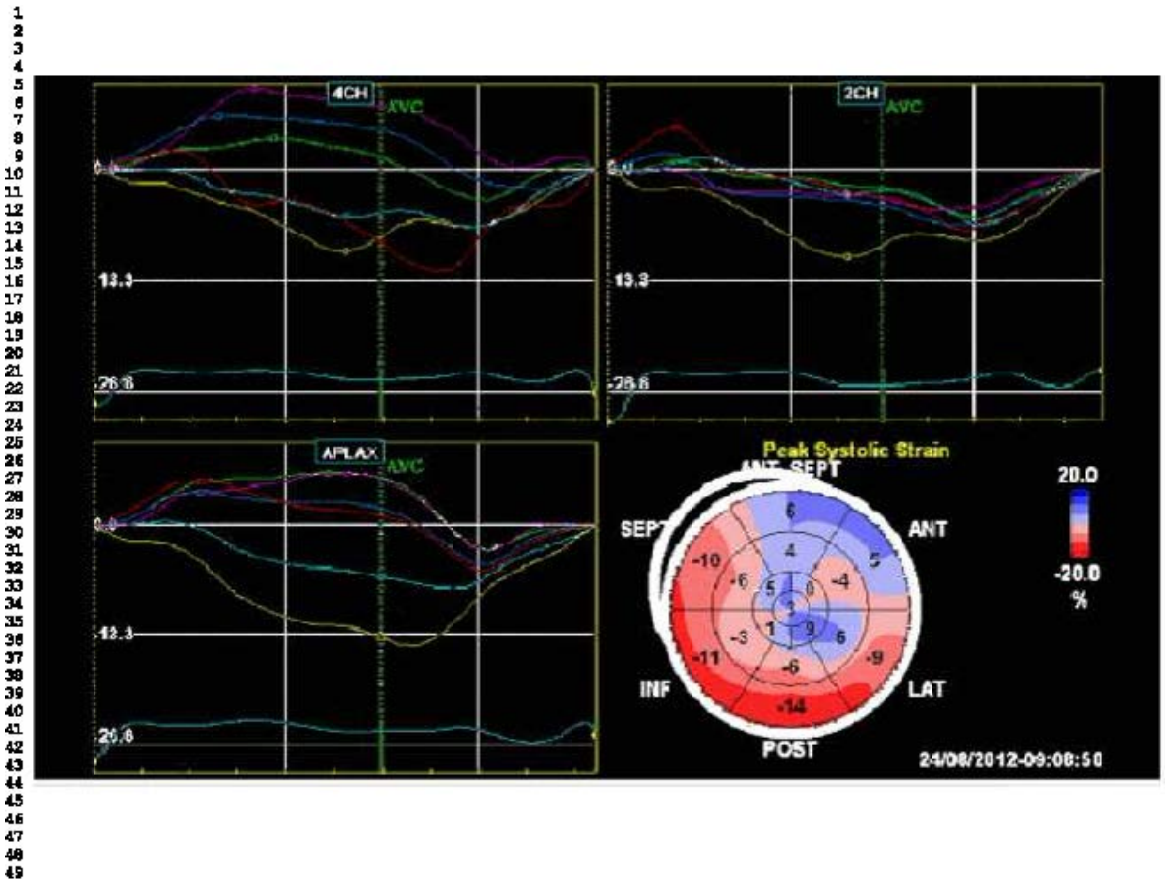

Figure 6: Strain analysis of this bullseye view shows hypokinesis in the anterior and apical regions of the left ventricle (strain 0 to 9%). Basal, septal, inferior and posterior regions appear to maintain kinesis at low normal range in figures 4 and 5.

and for use in determining appropriate therapy in the operating room. Strain pattern analysis is particular useful in the atypical presentation of TCM. In fact, literature suggests also that TCM involving the RV is not uncommon and may be a poor long term prognostic indicator [15]. Also, there are time differences in the functional recovery of regional myocardial deformation with respect to strain during the recovery phase despite normal LVEF. Consequently, strain analysis is an important tool in diagnosing, treating and predicting recovery and prognosis in TCM. Current 4D strain models tracking acoustic markers from 3D images and weighing strain in each frame over time may provide an even more accurate analysis of myocardial function allowing simultaneous longitudinal, circumferential, radial, and area strain per region of interest. Furthermore the current criterion for diagnosis of Takotsubo's cardiomyopathy should continue to evolve given the advancement in echocardiographic technology as well presentation of new cases with varying strain characteristics of both the LV and RV.

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