



## Introduction

Cardiac dysfunction and arrhythmias can develop in children with large burns. Recent studies have demonstrated perioperative and long-term cardiac dysfunction resulting in longer hospital stays.<sup>1-3</sup> Most at risk for developing cardiac abnormalities are patients with burns equal to or greater than 40% TBSA. When occurring in this population, the cardiac abnormality appears in the form of cardiac dysfunction or dilated cardiomyopathy as a presumed consequence of the burn-induced hypermetabolic response. In addition, cardiac arrhythmias can occur in burn patients of any size and may be a consequence of electrolyte abnormalities, circulating catecholamines, or underlying cardiac abnormality. The incidence of cardiac arrhythmias and dysfunction in the pediatric burn patient is unclear. Therefore, the primary objective of this prospective study was to evaluate the incidence and extent of cardiac arrhythmias and dysfunction in the pediatric burn patient with the hope that early recognition and management of burn-induced cardiac dysfunction and arrhythmias may improve clinical outcomes and limit length of hospital stay.

## Materials and Methods

Pediatric burn patients ages 0 - 18 years who sustained a burn injury greater than or equal to 30% and/or developed cardiac dysfunction and arrhythmia were enrolled in this study after obtaining IRB approval. Exclusion criteria involved patients with a pre-existing cardiac disorder, desquamative skin disorders and electrical injury. Due to declining large burn injuries, 30% TBSA was chosen to increase sample size.

For patients with burns equal to or greater than 30% TBSA, a baseline echocardiogram (ECHO) was obtained within one week of admission and then on a monthly basis. Echocardiogram tests were discontinued after three normal studies or upon discharge. If a cardiac issue developed, management would be determined by the Cardiology team with plans to monitor cardiac abnormalities up to 4 years post-discharge to assess for reversibility of disease.

## Results

### Demographics and Incidence

A total of 130 acute burn patients were admitted between 7/2017-10/2018, and 10 patients met enrollment criteria.

The mean patient age was 5 years (0.8 - 10 yrs). Males accounted for 70%, and 90% sustained flame burn injuries. Total TBSA average was 45% (24-70%) with average full thickness burns of 33% (0-67%). A total of 20 ECHO studies and 21 electrocardiograms (EKG) were obtained. Only 3 patients experienced cardiac symptomatology, reflecting an incidence rate of 2%.

### Cardiac Issues

One patient had prolonged bradycardia dropping from a baseline of 120-140 bpm to 80-90 bpm range. EKG reading was concerning for probable anterior wall MI. However troponins, ECHO and clinical evaluation were not consistent with this reading. A severe side effect to Precedex despite discontinuation was felt to be the etiology for this bradycardia.

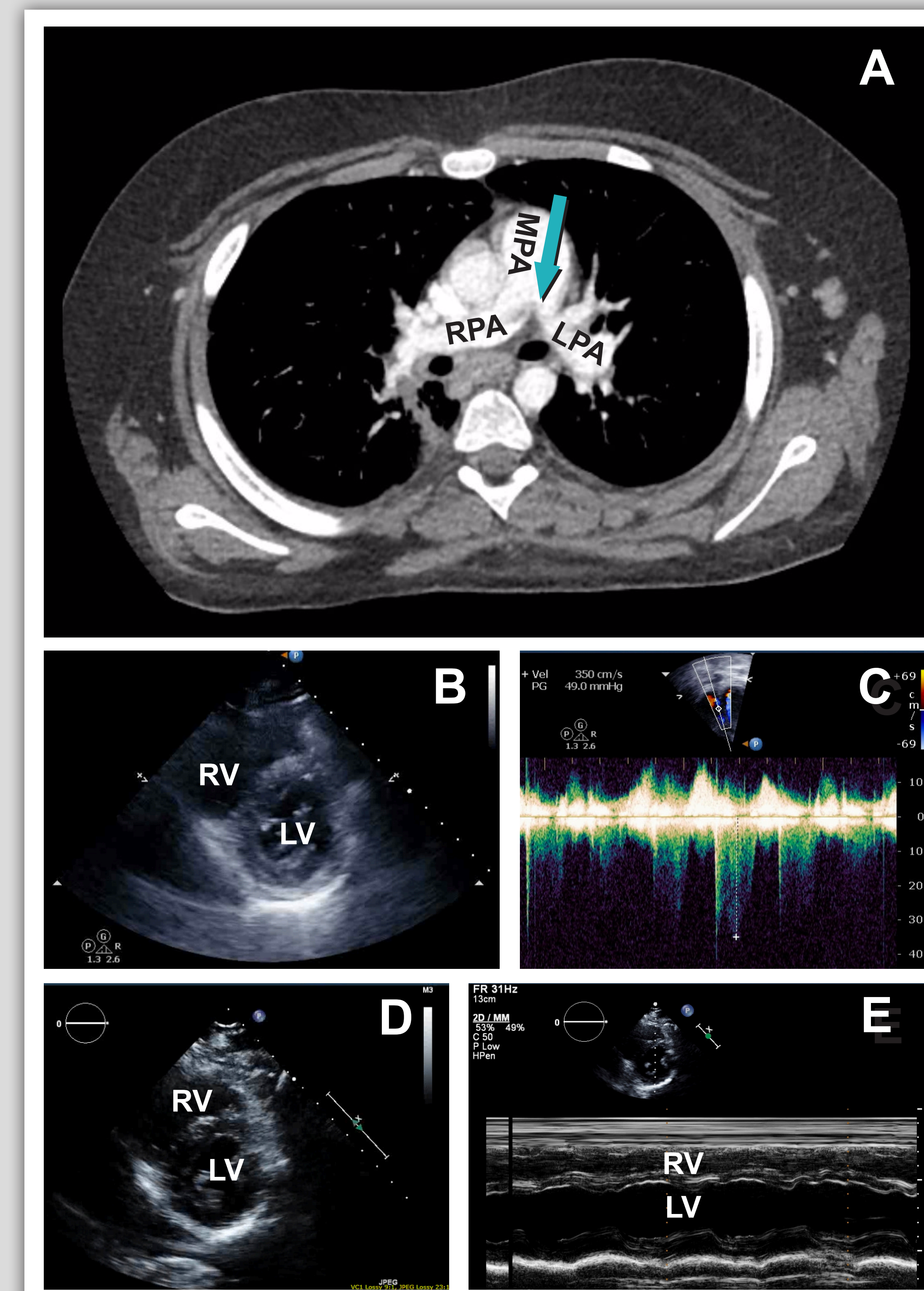
Another patient demonstrated asymptomatic bradycardia with deep sleep, that required no intervention.

The final symptomatic patient had 25% TBSA burn, and experienced four bradycardic arrests within the first hours of admission, caused initially by PEA arrest at the referring hospital after aspiration with intubation and receipt of multiple pain medications. Responding to epinephrine, the bradycardia events resolved. Admission ECHO demonstrated severe left ventricular dysfunction with an ejection fraction (EF) of 25% and normal EKG. Repeat ECHO within 4 days and subsequent ECHOs demonstrated full recovery with normal EF (**Fig 1**). However, on hospital day 30 he developed acute dyspnea and a CT scan identified small bilateral pulmonary emboli, and a non occlusive saddle pulmonary embolus (**Fig 1**). His echocardiogram at that time identified signs of elevated pulmonary pressures, which resolved within 6 days following systemic anticoagulation therapy.

The remaining patients, despite large TBSA injuries, did not exhibit any abnormalities on ECHO examinations aside from trivial tricuspid regurgitation. Electrolyte panels for both patients with cardiac events did not demonstrate any significant findings (Potassium 3.3-4.2; Magnesium 1.8-2.1; Phosphorous 3.4-5), and despite electrolyte shifts in the remaining non-cardiac patients, no arrhythmias occurred. Given these negative findings and the cost involved with ECHO examination, it was elected to discontinue the prospective study.

## Applicability to Practice

**The incidence of cardiac disease in the pediatric burn population is low. Preemptive use of ECHO in patients with large burns does not provide earlier recognition of cardiac disease.**



**Figure 1.** A. Chest CT with contrast identifying non-occlusive saddle pulmonary embolus (arrow) between pulmonary arteries (MPa, RPA, LPA). B & C. ECHO with flattened ventricular septum between the right (RV) and left ventricle (LV), and elevated right ventricular pressures. D & E. ECHO 6 days after systemic anticoagulation with normal ventricular septum morphology, RV pressures and systolic function.

## Conclusions

Although cardiac dysfunction and arrhythmias can have a significant impact on burn patients when present, the incidence of cardiac disease in the pediatric burn population is low. Elective ECHOs in large burns did not demonstrate abnormal findings. Use of ECHO is best performed on symptomatic burn patient populations.

## References

1. Mak GZ, Hardy AR, Meyer RA, and Kagan RJ. Reversible Cardiomyopathy After Severe Burn Injury. *J Burn Care Res* 2006;27:482-486.
2. Howard TS, Hermann DG, McQuitty AL, Woodson LC, Kramer GC, Herndon DN, Ford PM, Kinsky MP. Burn- Induced Cardiac Dysfunction Increases Length of Stay in Pediatric Burn Patients. *J Burn Care Res* 2013;34:413-419.
3. Guillory AN, Clayton RP, Herndon DN, Finnerty CC. Cardiac Dysfunction following Burn Injury: What we have learned from Rat and Mouse Models. *Int J Mol Sci* 2016 Jan2; 17(1)pii:E53.

