STEROIDS & INFLAMMATION

in Pediatric VADs

**BACKGROUND**

Systemic inflammation may result from chronic heart failure prior to implant or from the interaction of blood with the artificial surfaces of the VAD. Given that a pro-inflammatory state may predispose to hypercoagulability, many centers have elected to use a short course of systemic glucocorticoids. While there is limited published outcome data available about this approach, many centers have found corticosteroid therapy beneficial in maintaining adequate anticoagulation.

**ACTION REVISED DATE:** 12/11/2019

**OBJECTIVES**

To provide a standardized approach to the monitoring, evaluation, and treatment of systemic inflammation in children undergoing paracorporeal VAD support.

**PROTOCOL**

**Monitoring:**

* Obtain baseline inflammatory markers (CRP or high-sensitivity CRP, fibrinogen) following VAD implantation
* Recommend trending inflammatory markers daily for 7 days post-implant and then weekly thereafter or with any clinical concerns, such as new onset fever or difficulty maintaining adequate anticoagulation. For smaller children, may modify frequency to minimize blood draws.

**Evaluation:**

May consider beginning glucocorticoid therapy if:

1. New onset fever with negative initial cultures and infectious work-up
2. Elevated inflammatory markers. Centers have used the following cut off values:
   * CRP > 15 mg/dL or unexplained increase from post-implant baseline
   * High-sensitivity CRP > 70 mg/dL or unexplained increase from post-implant baseline
   * Fibrinogen > 600 mg/dL or unexplained increase from post-implant baseline
3. Inadequate anticoagulation despite being within therapeutic range
4. Need for rapid escalation or decrease in anticoagulation with no other clear identified etiologies (i.e. stable renal/hepatic function, adequate medication delivery)

**Treatment:**

***Initial Dose***: Methylprednisolone 2 mg/kg IV (maximum dose: 60 mg/day)

***Days 1-5***: Methylprednisolone 1 mg/kg IV q 12 hrs (maximum daily dose: 60 mg/day)

* Duration may be increased if inadequate response
* Some centers have reported using up to 15 mg/kg pulse in unresponsive patients

***Taper***: If inflammatory markers have begun to normalize (CRP < 4 mg/dL, hs-CRP < 30 mg/dL, fibrinogen < 400 mg/dL) and adequate control of anticoagulation can begin to taper over 3-5 days. A longer taper may be necessary if patient required a greater duration of steroid therapy.

***Additional considerations****:*

May consider omega-3 fatty acid supplementation to augment inflammatory response. There is limited data regarding dosing; however, centers have used 500 mg BID for all ages.

With glucocorticoid therapy, recommend monitoring for side effects such as hypertension, hyperglycemia, impaired wound healing, fluid retention, and alterations in INR.

Recommend concomitant H2 blocker or proton pump inhibitor prophylaxis therapy to minimize gastritis.

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**CONTRIBUTING CENTERS**

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**REFERENCES**

1. Yu X, Larsen B, Rutledge J, West L, Ross DB, Rebeyka IM, Buchholz H, Li J. The profile of the systemic inflammatory response in children undergoing ventricular assist device support. Interact Cadiovasc Thorac Surg, 2012 Sep; 15(3): 426-32
2. Radley G, Pieper IL, Ali S, Bhatti F, Thornton CA. The inflammatory response to ventricular assist devices. Front Immunol. 2018 Nov 15; 9: 2651
3. Machlus KR, Cardenas JC, Church FC, Wolber AS. Causal relationship between hyperfibrinogenemia thrombosis, and resistance to thrombolysis in mice. Blood. 2011; 117(18): 4963
4. Byrnes JW, Bhutta AT, Rettiganti MR, Gomez A, Garcia X, Dyamenahalli U, Johnson C, Jaquiss RD, Imamura M, Prodhan P. Steroid therapy attenuates acute phase reactant response among children on ventricular assist device support. Ann Thorac Surg. 2015 Apr; 99(4): 1392-8.

***Disclaimer:*** *The ACTION network is focused on quality improvement efforts such as harmonizing best practice protocols, disseminating them among institutions, and helping centers to improve care practices at the local level. This protocol was developed as a consensus tool for pediatric VAD programs. The information in the protocols are based on center practices, individual opinions, experiences, and, where available, published literature. Centers may choose to adapt this protocol to include in their center-specific protocols with reference to ACTION with the understanding that these are meant as guidelines and not standard of care. (Revised: 12/11/19)*