

FONTAN CLINICAL PATHWAY

EXECUTIVE SUMMARY

Physician Owner(s): Dr. Laura Ortmann, Dr. John Cramer, Dr. Melissa Wehrmann, Dr. Camille Hancock-Friesen



Primary Objective

Standardize management of patients post-operatively after elective Fontan procedure in the Cardiac Care Unit (CCU) and effectively transition to an outpatient setting with a goal of reducing chest tube duration, reducing hospital length of stay, and decreasing need for hospital re-admission.

Recommendations

- Patient population: All elective Fontan procedures, extubated in the operating room or shortly after CICU admission, off all vaso-pressors > 4 hours at 0700 AM POD 1 (excluding prophylactic vasopressin at 0.0002 mcg/kg/min).
- Patients will be initiated on the following regimen:

F – IV FUROSEMIDE 1mg/kg every 8h on POD 1¹. Spironolactone/hydrochlorothiazide (aldactazide) 1mg/kg PO every 12 hours to be initiated when taking enteral liquids^{1,2}. Transition to PO TID furosemide after chest tubes are removed. Diuretics will be weaned prior to discharge with a goal at discharge of 3-4 doses per day of diuretic. Goal for patients is to maintain electrolyte evidence of mild dehydration (near normal electrolytes, mild elevation in BUN, and normal creatinine).

O – Do not wean **OXYGEN** below 0.5 L/min via nasal cannula until chest tubes are removed¹⁻³. PT/OT should be consulted to assist with ambulation; okay for patient to be off oxygen while ambulating.

N – Initiate **ENALAPRIL** 0.05mg/kg/dose every 12h when taking PO fluids^{3,4}. Dose to be titrated up as needed for hypertension.

T – **CHEST TUBES** will be removed when drainage is < 2ml/kg/day for a single chest tube.

A – ANTICOAGULATION Patients will be placed on a heparin drip POD 0 (when 4 hours post op and chest tube output < 1 ml/kg/hour), maintain therapeutic Anti-Xa (0.3-0.7) until they are walking^{5,6}. Start aspirin on POD 1 when taking PO⁷⁻⁹. If patient is not taking PO on POD#1, start aspirin as soon as they are tolerating enteral liquids. **ALTERNATIVELY**, consider rivaroxaban instead of aspirin once CTs are removed for a duration of 6 months (**heparin should be stopped when rivoxaban started**)¹⁰.

N – NUTRITION and fluids: On POD 1-3, when PO is initiated, restrict total fluids to 80% of maintenance¹⁻³ and maintain on a on fat free diet (<3 grams of fate). On POD #4 increase to maintenance fluids until chest tubes are removed and increase to fat allowance to < 30% of total calories until 4 weeks post op¹.

S – SET-UP Discharge: Verbal hand-off to referring cardiologist. Patients should be instructed to maintain fluid restriction (~1.5 L/day) until seen by outpatient cardiologist. A CXR and BMP will be obtained 3 days after discharge for the referring cardiologist to review; expected cardiologist clinic visit within 1 week.

FONTAN CLINICAL PATHWAY

EXECUTIVE SUMMARY

Physician Owner(s): Dr. Laura Ortmann, Dr. John Cramer, Dr. Melissa Wehrmann, Dr. Camille Hancock-Friesen



Rationale

- Safety: Will be maintained by close communication between CICU physician, ICU cardiologist, CT surgeon, CT surgery advanced practice providers, inpatient Cardiologist and inpatient Cardiology nurse
- Quality: Will be improved by reducing practice variation
- Cost: Will be reduced by reducing practice variation in treatment which can lead to potential increased LOS, morbidity and readmissions
- Engagement: Is created and supported by involvement of providers across the continuum of care that evaluate and treat cardiology patients
- Patient/Family Satisfaction: Shall be improved by providing the highest quality care based on established guidelines and the latest evidence available in the literature

Metrics

Process metrics:

- Increase percent of patients started on aspirin on POD 1.
- Increase percent of patients discharged on a minimum of three times daily diuretics

Outcome metrics:

- Maintain median chest tube time of no more than 4 days.
- Decrease percent of patients readmitted for pleural effusions.

Balancing metric:

- No increase in number of patients readmitted for electrolyte derangements

Team Members

Champions: Laura Ortmann, MD (Cardiology) & John Cramer, MD (Cardiology)

- Melissa Wehrmann, MD (Cardiology)
- Camille Hancock-Friesen, MD (Cardiothoracic Surgery)
- Emily McLouth, PharmD (Pharmacy)
- Brandi Robinson, APP (CCU)
- Kady Condrey, (Dietician)
- Katelyn Anderson, RN (CCU Nurse Navigator)
- Abbie Vollers, RN (Fontan Coordinator)
- Kristy Cook, APRN (Fontan Program)

Evidence

1. Pike NA, Okuhara CA, Toyama J, Gross BP, Wells WJ, Starnes VA. Reduced pleural drainage, length of stay, and readmissions using a modified Fontan

FONTAN CLINICAL PATHWAY

EXECUTIVE SUMMARY

Physician Owner(s): Dr. Laura Ortmann, Dr. John Cramer, Dr. Melissa Wehrmann, Dr. Camille Hancock-Friesen



- management protocol. *J Thorac Cardiovasc Surg.* 2015;150(3):481-487. doi:10.1016/j.jtcvs.2015.06.042
2. Cava JR, Bevandic SM, Steltzer MM, Tweddell JS. A medical strategy to reduce persistent chest tube drainage after the fontan operation. *Am J Cardiol.* 2005;96(1):130-133. doi:10.1016/j.amjcard.2005.03.034
 3. Sunstrom RE, Muralidaran A, Gerrah R, et al. A defined management strategy improves early outcomes after the Fontan procedure: the PORTLAND protocol. *Ann Thorac Surg.* 2015;99(1):148-155. doi:10.1016/j.athoracsur.2014.06.121
 4. Mahle WT, Todd K, Fyfe DA. Endothelial function following the Fontan operation. *Am J Cardiol.* 2003;91(10):1286-1288. doi:10.1016/s0002-9149(03)00289-3
 5. McCrindle BW, Manlihot C, Cochrane A, et al. Factors associated with thrombotic complications after the Fontan procedure: a secondary analysis of a multicenter, randomized trial of primary thromboprophylaxis for 2 years after the Fontan procedure. *J Am Coll Cardiol.* 2013;61(3):346-353. doi:10.1016/j.jacc.2012.08.1023
 6. Ankola AA, Anderson BR, Choudhury TA, et al. Early Thromboprophylaxis Initiation is Associated With Reduced Fontan Thromboses in the Early Postoperative Period. *Seminars in Thoracic and Cardiovascular Surgery.* 2021;33(3):806-813. doi:10.1053/j.semthor.2020.12.008
 7. Jacobs ML, Pourmoghadam KK, Geary EM, et al. Fontan's operation: is aspirin enough? Is coumadin too much? *Ann Thorac Surg.* 2002;73(1):64-68. doi:10.1016/s0003-4975(01)03068-5
 8. Alsaied T, Alsidawi S, Allen CC, Faircloth J, Palumbo JS, Veldtman GR. Strategies for thromboprophylaxis in Fontan circulation: a meta-analysis. *Heart.* 2015;101(21):1731-1737. doi:10.1136/heartjnl-2015-307930
 9. Miwa K, Iwai S, Nagashima T. Anticoagulation Therapy After the Fontan Procedure. *Pediatr Cardiol.* 2022;43(6):1271-1276. doi:10.1007/s00246-022-02848-6
 10. Kawamatsu N, Ishizu T, Machino-Ohtsuka T, et al. Direct oral anticoagulant use and outcomes in adult patients with Fontan circulation: A multicenter retrospective cohort study. *Int J Cardiol.* 2021;327:74-79. doi:10.1016/j.ijcard.2020.11.024