Cardiac and non-cardiac organ transplantation

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Introduction

- Circulatory failure, occurring in an acute but profound fashion, or at times, in a more subtle but prolonged fashion can result in end organ dysfunction
- If a surgical option is not available, then cardiac transplantation may become the best option to correct the circulatory failure
- If a normal cardiac output is restored, end organ dysfunction may reverse itself, but occasionally it does not
- Continued end organ dysfunction may result in the need for a second organ transplant

Introduction

- The organs at greatest risk for ischemic injury (other than the brain) are the kidney and the liver

- We'll look at both simultaneous pediatric heart-kidney and heart-liver transplantation

Heart-kidney transplant

- Relatively uncommon

  (Choudhry, et al Pediatr Transplant Feb 22)

- 25 year national cohort study SRTR database (1992-2017)
  - Patients ≤ 21 years old
  - 9245 heart transplants
  - 63 heart-kidney transplants (0.7%)
  - Patients on dialysis at the time of transplant or with an eGFR≤ 35 ml/min/1.73 m2 did significantly better with sHKTx than with heart transplant alone

Heart-kidney transplant

- Patients not on dialysis or with a eGFR > 35 ml/min/m2 had no better outcome with sHKTx than with heart transplant alone
- Actuarial survival at 1 and 5 years post-sHKTx was 87% and 81.5% respectively and was not different from survival rates for pediatric heart transplant alone in those without significant renal insufficiency

Heart-kidney transplant

(*Dani, et al J Thorac Cardiovasc Surg Dec 2022)*

- UNOS registry (Jan 1987-Mar 2020)
- Listed peds patients: 109 listed for sHKTx and 318 for heart transplant alone with significant renal insufficiency (dialysis or eGFR <40)
- Patients receiving heart alone without renal insufficiency had a longer mean survival that those receiving heart alone with renal insufficiency (14.6 yrs vs 7.6 yrs)
- Patient receiving sHKTx had the same 1 and 5 year survival (86 and 81%) as noted in the study by Choudhry, et al)

Heart-Liver Transplant

- Pediatric heart-liver transplant has been performed even less commonly than heart-kidney

  (Choudhry, et al Pediatr Transplant Nov 21)

- 25 year national cohort study SRTR database (1992-2017)
  - Patients ≤ 21 years old
  - 9245 heart transplants
  - 20 heart-liver transplants (0.2%)

Heart-Liver Transplant

- New concern: Fontan associated liver disease (FALD)
- Palliated single ventricle circulation never has normal hemodynamics
- Chronic elevated central venous pressure can result in liver scarring
- By adolescence, most Fontan patients have some evidence of liver fibrosis
- As patients develop a “failing Fontan” physiology, progressive liver disease might be expected

Heart-Liver Transplant

- How should one go about evaluating for FALD?
- When is dual organ heart-liver transplant indicated?

Heart-Liver Transplant

- *"Fontan-Associated Liver Disease: Screening, Management and Transplant Considerations"*

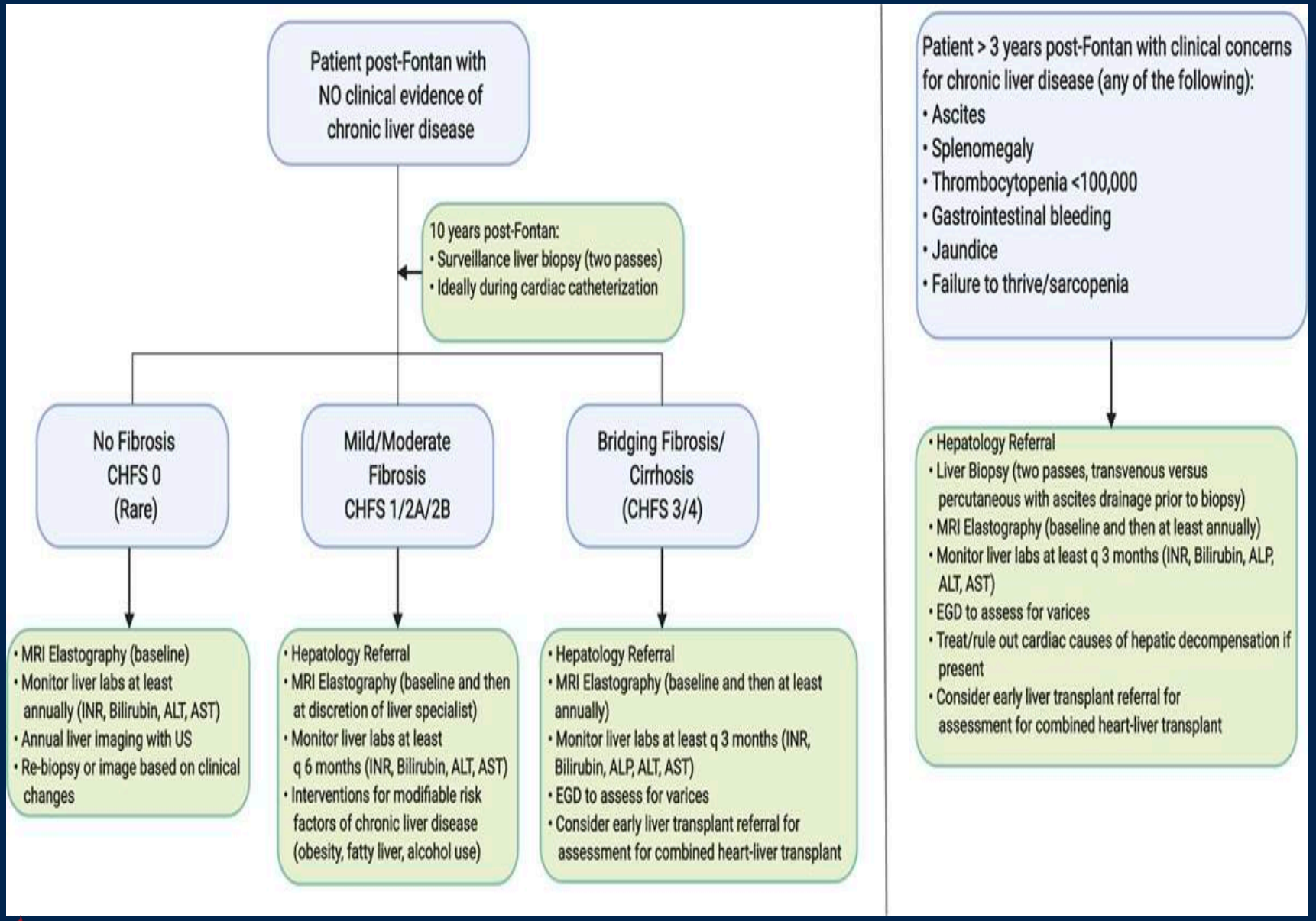
  Emamaullee, et al, *Circulation* 2020 142: 591-604

- *"Orthotopic Heart and Combined Heart Liver Transplantation: the Ultimate Treatment Option for Failing Fontan Physiology"*

  Reardon , et al *Current Transplantation Reports 2021 8:9-20*

- *"Clinical Approach to the Transplant Evaluation for a Patient with Fontan Physiology"*

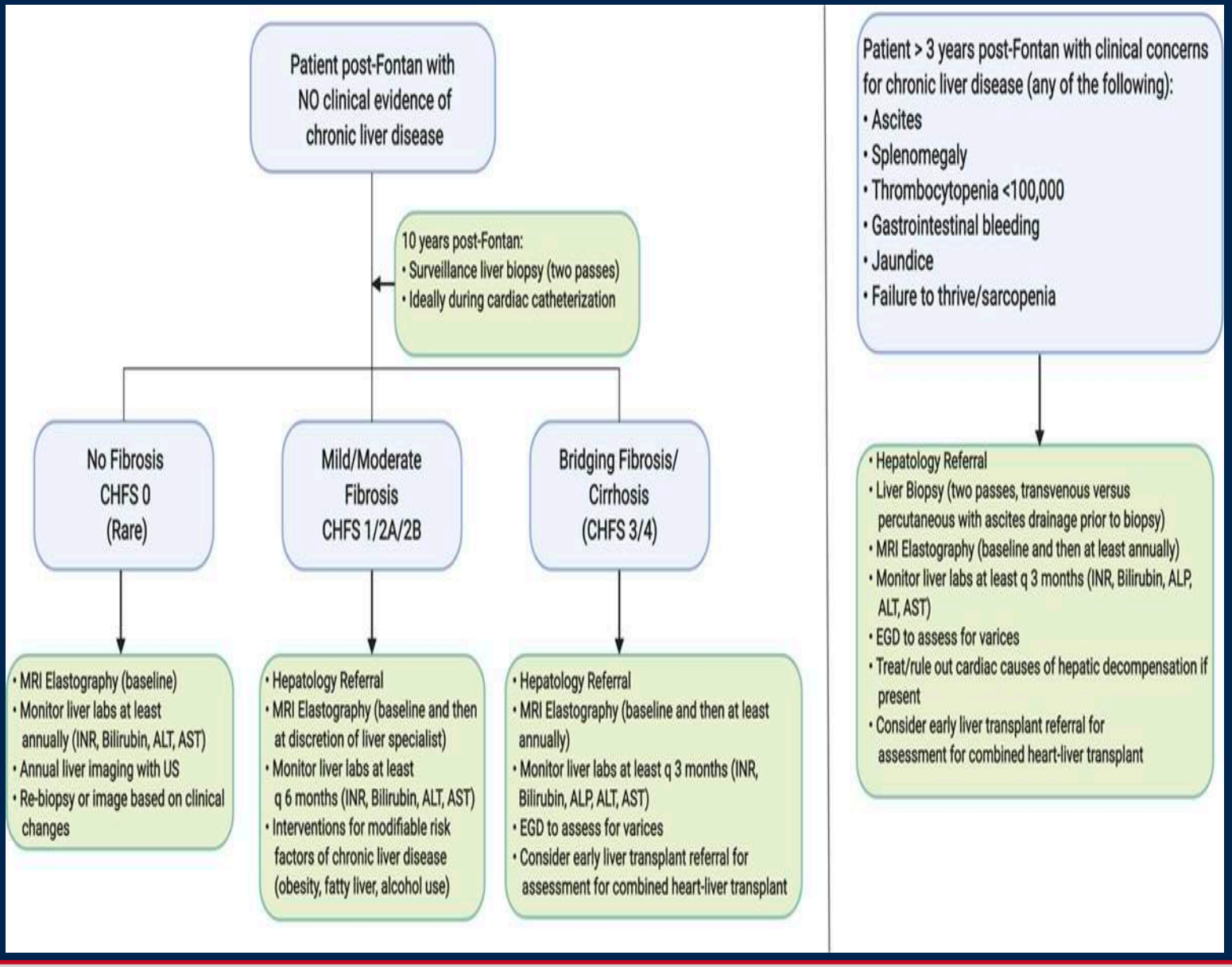
  PHTS 2023



Juliet Emamaullee. Circulation. Fontan-Associated Liver Disease, Volume: 142, Issue: 6, Pages: 591-604, DOI: (10.1161/CIRCULATIONAHA.120.045597)

Heart-Liver Transplant

- Strongest indicators for combined heart-liver transplant are biopsy driven
  - Bridging fibrosis
  - Cirrhosis
  - Hepatocellular carcinoma



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Heart-Liver Transplant

- Programs reporting their experience with heart-liver transplant in Fontan patients;
  - Mayo clinic 4 (2016)
  - UCLA 5 (2018)
  - Stanford 9 (2019)
  - Philadelphia 11 (2019)

  All adult age patients

Heart-Liver Transplant

- Fontan patients are generally the most difficult transplant patients we must address

- Our surgeons face an already complex anatomy, heterotaxy, a difficult explant after prior surgeries, poor tissue integrity and increased bleeding from collaterals
- Post-op there may be vasoplegia, coagulopathy, thrombocytopenia, hypoalbuminemia, poor wound healing, HLA sensitization, increased risk of infection, AKI

- Adding a second organ to transplant could add to and complicate any of these concerns

TCH 10 year experience

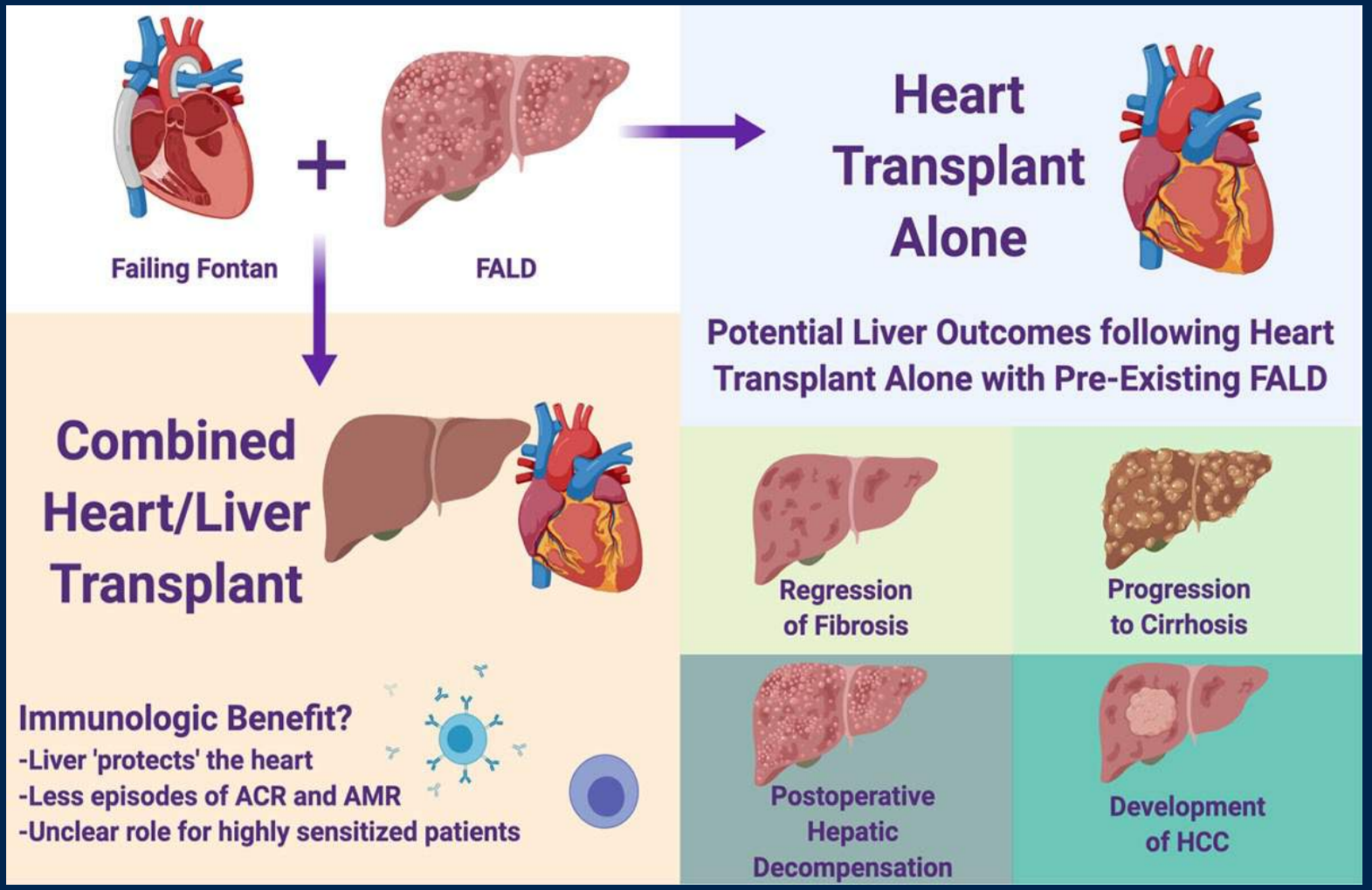
- Heart transplants performed at TCH January 2013-December 2022
- Total: 264
- TP for congenital heart disease: 113 (43%)
- TP for failed Fontan physiology: 30
- Survivors to date: 26/30 (87%)
- COD: TCAD 2, SCD 1, MSOF 1

TCH 10 year experience

- Number of combined heart-liver transplants performed:

0

(age range 4-26 years, avg age 19, median age 12)



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Heart-Liver Transplant: Summary Statements

- “The decision as to whether a patient may benefit from single or multi-organ transplantation is challenging and fraught with little data to support or refute any given approach.”
- “A multi-disciplinary, closely integrated, and frequently communicative team is essential to any program that seeks to perform heart or multi-organ transplantation on failing Fontan patients.”

Reardon, et al, *Current Transplantation Reports* (2021) 8:9-20

Conclusion

- Dual organ transplants in the pediatric age population (heart-kidney, heart-liver) remain uncommon events but are likely to increase as our patient population and our comfort with these procedures changes.

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