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A clinical trial comparing how well two solutions protect the heart during heart surgery in children

Submission date 26/07/2021	**Recruitment status** No longer recruiting	[X] Prospectively registered [X] Protocol
Registration date 28/07/2021	**Overall study status** Completed	[X] Statistical analysis plan [_] Results
Last Edited 23/01/2026	**Condition category** Circulatory System	[_] Individual participant data [X] Record updated in last year

Plain English summary of protocol

Background and study aims

This study aims to improve the outcomes of children's heart surgery so that they recover faster with fewer complications. Children with congenital heart defects often need operations to correct the abnormalities that they were born with. The surgery is complex and usually involves a period of support on a heart-lung machine (cardiopulmonary bypass). This allows the heart to be stopped for a short period of time, using a fluid called cardioplegia solution, whilst the defect is repaired. Inevitably, any surgery puts a strain on the heart and has the potential to cause damage. In this study, we will compare two types of cardioplegia solution used to stop the heart: del Nido, the most commonly used in children in the US, and St Thomas', currently the standard practice in the UK, to determine which solution protects the heart better, and whether children recover faster and with fewer complications, so that we can improve the outcomes of children's heart surgery.

Who can participate?

Children aged less than 16 years who are undergoing heart surgery requiring cardioplegia.

What does the study involve?

During the operation, the heart will need to be stopped for a period of time so that the surgeon can repair the heart defect. Being involved in this study will not affect whether the heart needs to be stopped during the operation – the only change will be the type of cardioplegia solution that is used. Both del Nido and St Thomas' cardioplegia solutions are in routine clinical use in hospitals around the world and have been used in many thousands of children's heart operations.

What are the possible benefits and risks of participating?

This trial will increase our understanding of which cardioplegia is better in children but there may not be any direct benefit for a child taking part. Whilst some previous studies have suggested that del Nido cardioplegia may better protect children's hearts during surgery, we do not know if it is beneficial to all children and whether they recover faster with fewer complications - that is why we are conducting this study. We do not know whether being in the study will make your child's surgery safer, but we are conducting it to understand how to

improve the outcomes of children's heart surgery in the future. Both types of cardioplegia are used routinely for heart surgery in children, del Nido in the US and St Thomas' in the UK. The operation itself carries a risk, as discussed with the Surgeon and Cardiologist, but being involved in this study causes no additional pain, discomfort, distress or intrusion.

Where is the study run from?
This trial is being coordinated by the DESTINY trial office at Birmingham Clinical Trials Unit (BCTU) and is sponsored by the University of Birmingham (UK).

When is the study starting and how long is it expected to run for?
June 2021 to July 2025

Who is funding the study?
British Heart Foundation

Who is the main contact?
DESTINY trial office, DESTINY@trials.bham.ac.uk

Contact information

Type(s)
Scientific

Contact name
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Additional identifiers

Clinical Trials Information System (CTIS)
2021-001915-10

Integrated Research Application System (IRAS)
279068

Central Portfolio Management System (CPMS)
49735

BHF grant code
CS/20/3/34738

Study information

Scientific Title
del Nido versus St. Thomas' blood cardioplegia in the young (DESTINY) trial: a multi-centre randomized controlled trial in children undergoing cardiac surgery

Acronym
DESTINY

Study objectives
To determine whether in children undergoing cardiac surgery, the use of del Nido cardioplegia, compared with St. Thomas' blood cardioplegia, will reduce myocardial injury during surgery.

Ethics approval required
Old ethics approval format

Ethics approval(s)
Approved 30/06/2021, West Midlands - Coventry & Warwickshire Research Ethics Committee (The Old Chapel, Royal Standard Place, Nottingham, NG1 6FS, UK; +44 (0)207 104 8009; coventryandwarwick.rec@hra.nhs.uk), ref: 21/WM/0149

Study design
Interventional randomized controlled trial

Primary study design
Interventional

Study type(s)
Treatment

Health condition(s) or problem(s) studied
Cardiac surgery

Interventions
The trial interventions are either del Nido cardioplegia (experimental arm) or St. Thomas' blood cardioplegia (control arm). del Nido cardioplegia is administered in a 1:4 blood:crystalloid preparation, given at 4-8°C, with an initial dose of 20ml/kg and subsequent doses every 60-90 minutes if required, at the discretion of the surgeon, as required. St. Thomas' blood cardioplegia is administered in a 4:1 blood:crystalloid using Harefield Hospital preparation, given at 4-8°C, with an initial dose of 20-30ml/kg, subsequent doses of 15 ml/kg every 20-30 minutes at the discretion of the surgeon, as required.

Blood samples will be taken at several time-points: before the operation, once the child is asleep under anaesthesia; and at 5 timepoints after the operation, at 3, 6, 9, 12 and 24 hours after surgery.

Following surgery, the child will be transferred to the Paediatric Intensive Care Unit and will be closely monitored. Follow-up in the trial will be until 30 days after the index operation.

Intervention Type
Procedure/Surgery

Primary outcome(s)
Area under the time-concentration curve (AUC) for plasma high-sensitivity troponin-I (µg.h/L) in the first 24 hours after the index aortic cross-clamp release (reperfusion).

Key secondary outcome(s))
Current secondary outcome measures as of 14/03/2024:

1. Low cardiac output syndrome (LCOS) defined as either of the following: Vasoactive Inotrope Score (VIS) ≥15, or major cardiac event (cardiac arrest, ECLS or death) in the first 48 hours after reperfusion
2. Duration of mechanical ventilation (hours), defined as the number of hours from termination of index CPB to extubation
3. Length of postoperative stay on Paediatric Intensive Care (hours), defined as number of hours from admission to PICU from theatre following index procedure to discharge from PICU
4. Maximum VIS by thresholds: ≥10, ≥15 and ≥20 in the first 48 hours after reperfusion
5. Total VIS in the first 4 hours after PICU admission following the index procedure (score)
6. Arterial lactate (mmol/L) in the first 12 hours after reperfusion
7. Omega, determined by [SaO2]/[SaO2-ScvO2] in the first 12 hours after reperfusion
8. Total aortic cross-clamp time (mins) during the index procedure
9. Total volume of cardioplegia given (ml) during the index procedure
10. Need for internal defibrillation during reperfusion during the index procedure
11. Delayed sternal closure, incidence and duration (days) following the index procedure
12. Unplanned reoperation, including chest re-opening on PICU, following the index procedure
13. Need for new renal replacement therapy following the index procedure
14. Lowest estimated glomerular filtration rate (eGFR), calculated using the bedside Schwartz equation and the peak postoperative creatinine on routine monitoring during the first 7 days following the index procedure (ml/min/1.73m²), and according to the paediatric RIFLE categories
15. Length of postoperative stay in the hospital (days), defined as number of days from day of the index procedure to discharge from hospital or death, whichever is sooner
16. 30-day survival following the index procedure

Previous secondary outcome measures:

1. Low cardiac output syndrome (LCOS) defined as either of the following: Vasoactive Inotrope Score (VIS) ≥15, or major cardiac event (cardiac arrest, ECLS or death) in the first 48 hours after reperfusion
2. Duration of mechanical ventilation (hours), defined as the number of hours from termination of index CPB to extubation
3. Length of postoperative stay on Paediatric Intensive Care (hours), defined as number of hours from admission to PICU from theatre following index procedure to discharge from PICU
4. Maximum VIS by thresholds: ≥10, ≥15 and ≥20 in the first 48 hours after reperfusion
5. Total VIS in the first 4 hours after PICU admission following the index procedure (score)

6. Arterial lactate (mmol/L) In the first 12 hours after reperfusion
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15. Length of postoperative stay in the hospital (days), defined as number of days from day of the index procedure to discharge from hospital or death, whichever is sooner
16. 30-day survival following the index procedure

Completion date
31/07/2025

Eligibility

Key inclusion criteria
Children (<16 years) undergoing cardiac surgery on cardiopulmonary bypass with cardioplegic arrest

Participant type(s)
Patient

Healthy volunteers allowed
No

Age group
Mixed

Lower age limit
0 years

Upper age limit
16 years

Sex
All

Total final enrolment
112

Key exclusion criteria
Current exclusion criteria as of 18/03/2025:

1. Predicted cross-clamp time <30 minutes (e.g. atrial septal defect, atrial septectomy, sub-aortic stenosis) at the discretion of the Consultant surgeon

2. Known contraindication to one of the constituents of either cardioplegia solution (e.g. lidocaine/procaine hypersensitivity/allergy) or its method of delivery, including temperature (e. g. haemoglobinopathy including sickle cell disease, cold agglutinins)
3. Ventricular assist device (VAD) insertion/explant or transplantation
4. Pre-operative inotropic support or extracorporeal life support (ECLS)
5. Previous cardiac surgery with cardioplegic arrest within the last 30 days
6. Previous enrolment in the DESTINY trial
7. Emergency surgery
8. Parent/guardian declines consent
9. Weight at the time of screening >50 kg

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Previous exclusion criteria as of 14/03/2024:

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2. Known contraindication to one of the constituents of either cardioplegia solution (e.g. lidocaine/procaine hypersensitivity/allergy) or its method of delivery, including temperature (e. g. haemoglobinopathy including sickle cell disease, cold agglutinins)
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5. Previous cardiac surgery with cardioplegic arrest within the last 30 days
6. Previous enrolment in the DESTINY trial
7. Emergency surgery
8. Parent/guardian declines consent
9. Weight at the time of surgery >50 kg

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Previous exclusion criteria:

1. Predicted cross-clamp time <30 minutes (e.g. atrial septal defect, atrial septectomy, sub-aortic stenosis) at the discretion of the Consultant surgeon
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3. Ventricular assist device (VAD) insertion/explant or transplantation
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5. Previous cardiac surgery with cardioplegic arrest within the last 30 days
6. Emergency surgery
7. Parent/guardian declines consent

(added 15/03/2023)
8. Weight at the time of surgery >50 kg
9. Previous enrolment in the DESTINY trial

Date of first enrolment
07/02/2022

Date of final enrolment
13/03/2025

Locations

Countries of recruitment
United Kingdom

England

Study participating centre
Birmingham Children's Hospital
Steelhouse Lane
Birmingham
England
B4 6NH

Study participating centre
Bristol Royal Hospital for Children
University Hospitals Bristol and Weston NHS Foundation Trust
Upper Mauldin Street
Bristol
England
BS2 8BJ

Study participating centre
Great Ormond Street Hospital
Great Ormond Street
London
England
WC1N 3JH

Study participating centre
Leeds General Infirmary (Children's Hospital)
The Leeds Teaching Hospitals NHS Trust
Great George Street
Leeds
England
LS1 3EX

Sponsor information

Organisation
University of Birmingham

ROR
https://ror.org/03angcq70

Funder(s)

Funder type
Charity

Funder Name
British Heart Foundation

Alternative Name(s)
The British Heart Foundation, the_bhf, BHF

Funding Body Type
Private sector organisation

Funding Body Subtype
Trusts, charities, foundations (both public and private)

Location
United Kingdom

Results and Publications

Individual participant data (IPD) sharing plan
Requests for access to data should be addressed to the Chief Investigator. Individual participant data collected during the trial (including the data dictionary) will be available, after deidentification, once published with no end date. All proposals requesting data access must specify how the data will be used, and all proposals will need the approval of the Trial Management Committee before data release.

IPD sharing plan summary
Available on request

Study outputs

Output type	Details	Date created	Date added	Peer reviewed?	Patient-facing?
Protocol article		14/04/2025	16/04/2025	Yes	No
HRA research summary			28/06/2023	No	No
Participant information sheet	Child version 1.0	25/03/2021	28/07/2021	No	Yes

Participant information sheet	Parent version 1.1a	06/07/2021	28/07/2021	No	Yes
Participant information sheet	Parent version 1.1b	06/07/2021	28/07/2021	No	Yes
Participant information sheet	Parent version 3.0a	05/10/2023	14/03/2024	No	Yes
Participant information sheet	Parent version 3.0b	05/10/2023	14/03/2024	No	Yes
Participant information sheet	Parent version 2.0a	27/08/2021	14/03/2024	No	Yes
Participant information sheet	Parent version 2.0b	27/08/2021	14/03/2024	No	Yes
Protocol file	version 1.0	26/05/2021	28/07/2021	No	No
Protocol file	version 2.0	19/08/2021	14/03/2024	No	No
Protocol file	version 3.0	22/08/2022	14/03/2024	No	No
Protocol file	version 4.0	25/10/2023	14/03/2024	No	No
Protocol file	version 5.0	14/02/2025	18/03/2025	No	No
Statistical Analysis Plan	version 2.0		23/01/2026	No	No
Study website		11/11/2025	11/11/2025	No	Yes