Utilisation of livers donated after circulatory death (DCD) for transplantation – a large cohort study evaluating pre-retrieval biochemical characteristics and transplant outcomes

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INTRODUCTION AND AIMS

- Donation after circulatory death (DCD) livers are at risk of:
    - Primary non-function (PNF)
    - Intra-hepatic-biliary stricture formation
    - Graft loss
- The risk of these complications has greatly inhibited the utilisation of DCD livers
- This study aims to identify pre-retrieval biochemical characteristics of DCD donors and evaluate the impact of DCD status on organ retrieval, utilisation and graft/recipient outcome.

METHODS

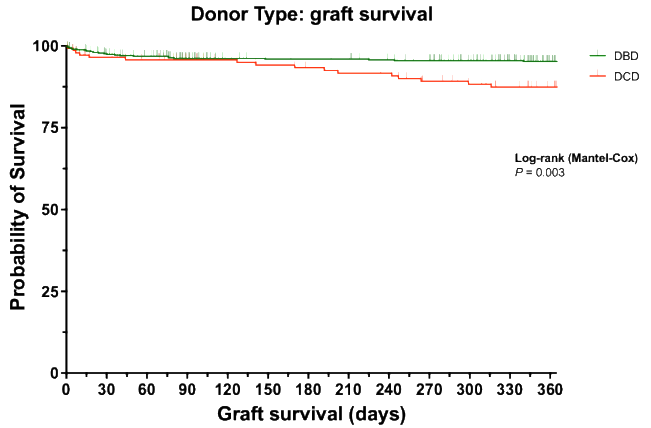
- A total of 1,048 consecutive donors between 2017-2019 were identified from the national Quality in Organ Donation (QUOD) bioresource and included in the study:
    - DBD *n* = 628
    - DCD *n* = 420
- Donor blood collected prior to retrieval was requested for biochemical analysis
- The Chi-square test was used for categorical data and the non-parametric Kruskal-Wallis test was used for continuous data
- Graft and patient survival were reported using Kaplan-Meier curves

RESULTS

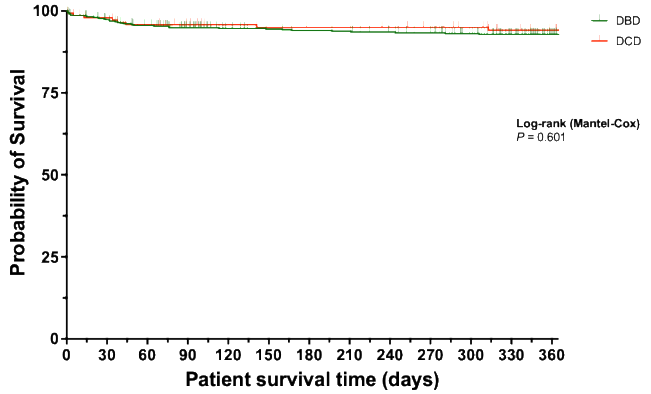
- The pre-retrieval biochemical measurements demonstrated greater hepatocellular injury and metabolic derangement in DCD compared to DBD donors ($P < 0.001$):
  - ALT = 38 IU/L (20.1-70.4) vs. 26.9 (16.2-57.5)
  - AST = 50.8 IU/L (28.0-83.6) vs. 29.9 (18.4-53.5)
  - GGT = 71.3 IU/L (30.8-177.2) vs. 40.1 (21.7-88.3)
  - Glucose = 6.3 mmol/l (5.1-7.9) vs. 8.2 (6.6-10.0)
  - Insulin = 84.7 pmol/l (47.0-157.7) vs. 185.6 (89.1-404.6)
- Only 212/420 (50.5%) of DCD livers compared to 578/628 (92%) of DBD livers were retrieved, and of these, only 143/212 (67.5%) of DCD livers and 510/578 (88.2%) of DBD livers were transplanted, $P < 0.001$ **(Table 1)**
- Recipients transplanted with DCD livers had a higher rate of biliary strictures i.e. 9.1% vs. 5.5% and significantly reduced graft survival at 12-months i.e. 88.8% vs. 95.5%, $P = 0.003$ **(Figure 1).** Cox proportional hazard regression analysis identified DCD donors and donor insulin as independent predictors of graft survival.

Donor demographics			
Median [IQR] & Column frequency [%]	**DBD (*n* = 628)**	**DCD (*n* = 420)**	***P* - value**
Age	54 [44-64]	57 [47-65]	0.044
Gender			
Male	309 [49.2]	254 [60.5]	<0.000
Female	319 [50.8]	166 [39.5]	
Donor ethnicity			
White	570 [90.8]	400 [95.2]	N/A
Asian	16 [2.5]	5 [1.2]	
Black	20 [3.2]	1 [0.2]	
Chinese/Oriental	2 [0.3]	3 [0.7]	
Mixed	4 [0.6]	2 [0.5]	
Other	12 [1.9]	6 [1.4]	
Not reported	3 [0.5]	1 [0.2]	
Unknown	1 [0.2]	2 [0.5]	
Weight (kg)	77 [65.0-90.0]	80 [70.0-90.0]	0.058
Height (cm)	171 [164-178]	171 [165-180]	0.197
BMI (kg/m²)	26.4 [23.1-29.7]	26.7 [23.7-29.7]	0.358
Waist Circumference (cm)	95 [86-105]	98 [87-107]	0.042
Diabetes	44 [7]	43 [10.2]	0.170
Hypertension	187 [29.8]	130 [31.0]	0.914
Liver disease	21 [3.3]	25 [6]	0.105
Smoking history	423 [67.4]	270 [64.3]	0.423
Cause of death			
Intracranial haemorrhage	396 [63.1]	179 [42.6]	N/A
Intracranial thrombosis	29 [4.6]	21 [5.0]	
Brain tumour	7 [1.1]	3 [0.7]	
Hypoxic brain damage	106 [16.9]	132 [31.4]	
Intracranial - CVA	16 [2.5]	13 [3.1]	
Trauma	21 [3.3]	19 [4.5]	
Cardiac arrest	3 [0.5]	7 [1.7]	
Myocardial infarction	-	1 [0.2]	
Pneumonia	-	2 [0.5]	
Respiratory failure	-	6 [1.4]	
Respiratory - type unclassified	-	1 [0.2]	
Meningitis	3 [0.5]	-	
Infections - type unclassified	2 [0.3]	-	
Acute blood loss (hypovolaemia)	1 [0.2]	-	
Other drug overdose	3 [0.5]	-	
Other	18 [2.9]	19 [4.5]	
Not reported	23 [3.7]	16 [3.8]	
Liver retrieved			
No	50 [8.0]	208 [49.5]	<0.000
Yes	578 [92.0]	212 [50.5]	

Table 1: Donor demographics demonstrating a significant reduction in retrieval of DCD donor livers.



Graft survival time (days)					
	Number at risk	**0**	**90**	**180**	**365**
Donor type	**DBD**	510	455	416	311
	DCD	143	126	115	88



Patient survival time (days)					
	Number at risk	**0**	**90**	**180**	**365**
Donor type	**DBD**	510	459	419	315
	DCD	143	129	120	99

Figure 1: Graft and patient survival reported using Kaplan-Meier curves

CONCLUSIONS AND ACKNOWLEDGEMENTS

- This study highlights:
    - Under-utilisation of DCD livers
    - Pre-retrieval biochemical/metabolic derangements that contribute to risk profile of these donors
- The clinical application of normothermic regional perfusion (NRP) and ex-situ machine perfusion technologies may enable donor liver functional assessment/optimisation in order to facilitate safe transplantation.
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