

NHS BLOOD AND TRANSPLANT

CARDIOTHORACIC ADVISORY GROUP – HEART

Outcomes of urgent heart transplantation in patients with LVAD-related complications in the UK

INTRODUCTION

1. LVAD-related complications are a common reason for requesting urgent heart transplant listing via the CTAG Adjudication Panel. An analysis of 66 patients urgently listed due to LVAD-related complications was presented at the last CTAG-Heart meeting. Forty-eight patients received a heart transplant and the one year survival rate was 56%, significantly lower than for other urgent heart transplant recipients (88%).
2. It was agreed that extra data and analysis was required to understand the factors that lead to poor outcomes in this group of patients. This information will help guide adjudication of cases for urgent listing in the presence of LVAD-related complications and potentially shape discussions on allocation of scarce donor organs.

DATA AND METHODS

3. All adult patients who were referred to the CTAG Adjudication Panel due to LVAD-related complications between 26 October 2016 and 30 September 2021 and received an urgent heart transplant were identified. By extending the cohort to 30 September 2021, 13 patients were added to the previous cohort of 48 patients, resulting in a cohort of 61 patients with varying numbers across centres:

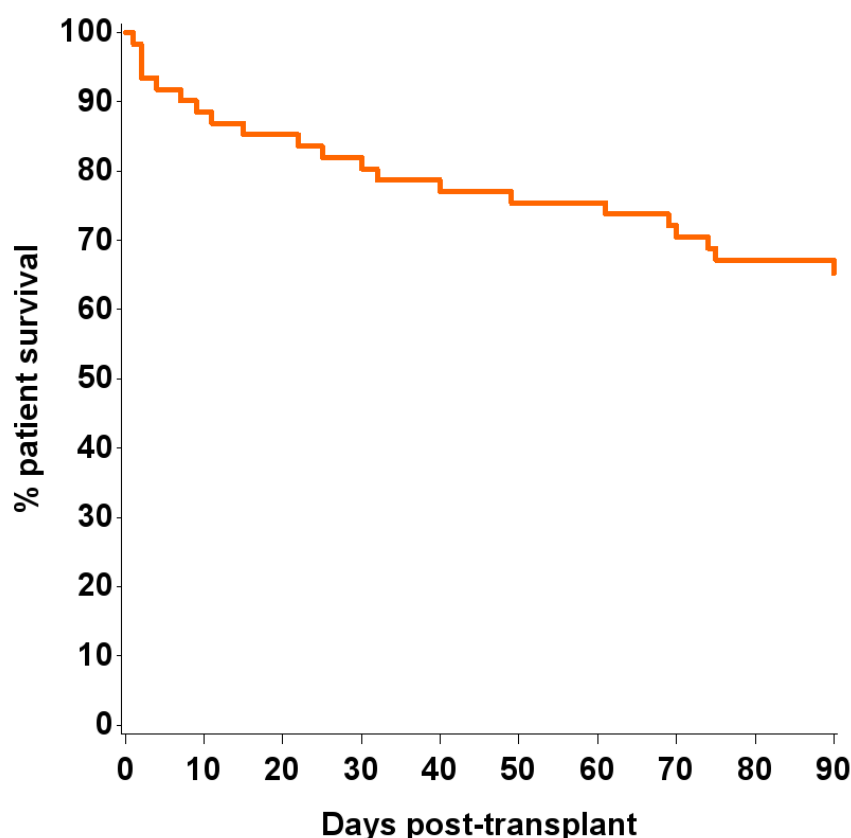
| Centre | Number of patients |
|------------|--------------------|
| Birmingham | 7 |
| Glasgow | 2 |
| Harefield | 17 |
| Manchester | 12 |
| Newcastle | 13 |
| Papworth | 10 |
| Total | 61 |

4. Key clinical data were provided by centres from the time of urgent heart transplant and combined with data on the UK Transplant Registry. The aim was to identify factors that explain the poor survival outcome of these patients. Analyses were performed using the Kaplan-Meier estimation method and log-rank test. P-values were considered significant at the 10% level due to the small sample size.
5. A subgroup analysis was performed excluding those who received a Total Artificial Heart (TAH) due to the particularly high mortality in this group of patients.

RESULTS

6. **Figure 1** presents the overall survival of patients in the analysis cohort. The 90 day survival rate was 65.2% (95% CI: 51.7-75.8). Note that the 90 day survival rate post heart transplant as published in the Annual Cardiothoracic Report is 88.3%.

Figure 1 90 day survival of patients who received an urgent heart transplant for LVAD complications



7. **Table 1** examines the effect of different factors on the likelihood of a patient surviving to 90 days post-transplant. These analyses were limited by the small sample size, and only a few factors were associated with increased risk of mortality: type of LVAD, presence of systemic infection, BMI, centre and ischaemia time. The effect of BMI is unlikely to be associated with BMI itself, as there was 100% survival in the overweight group. Similarly, as ischaemia time is correlated with centre which is also correlated with type of LVAD, the effects observed are likely to be associations rather than true effects.

Table 1 Examining impact of variables on 90 day survival of urgent patients transplanted due to LVAD-related complications

| Variable | Died within 90 days N=21 | | Alive at 90 days ¹ N=40 | | Log-rank p-value |
|--------------------------------|-----------------------------|----|---------------------------------------|----|------------------|
| | N | % | N | % | |
| <i>Number of complications</i> | | | | | |
| 1 | 14 | 35 | 26 | 65 | 0.6735 |
| More than 1 | 6 | 32 | 13 | 68 | |
| Unknown | 1 | | 1 | | |

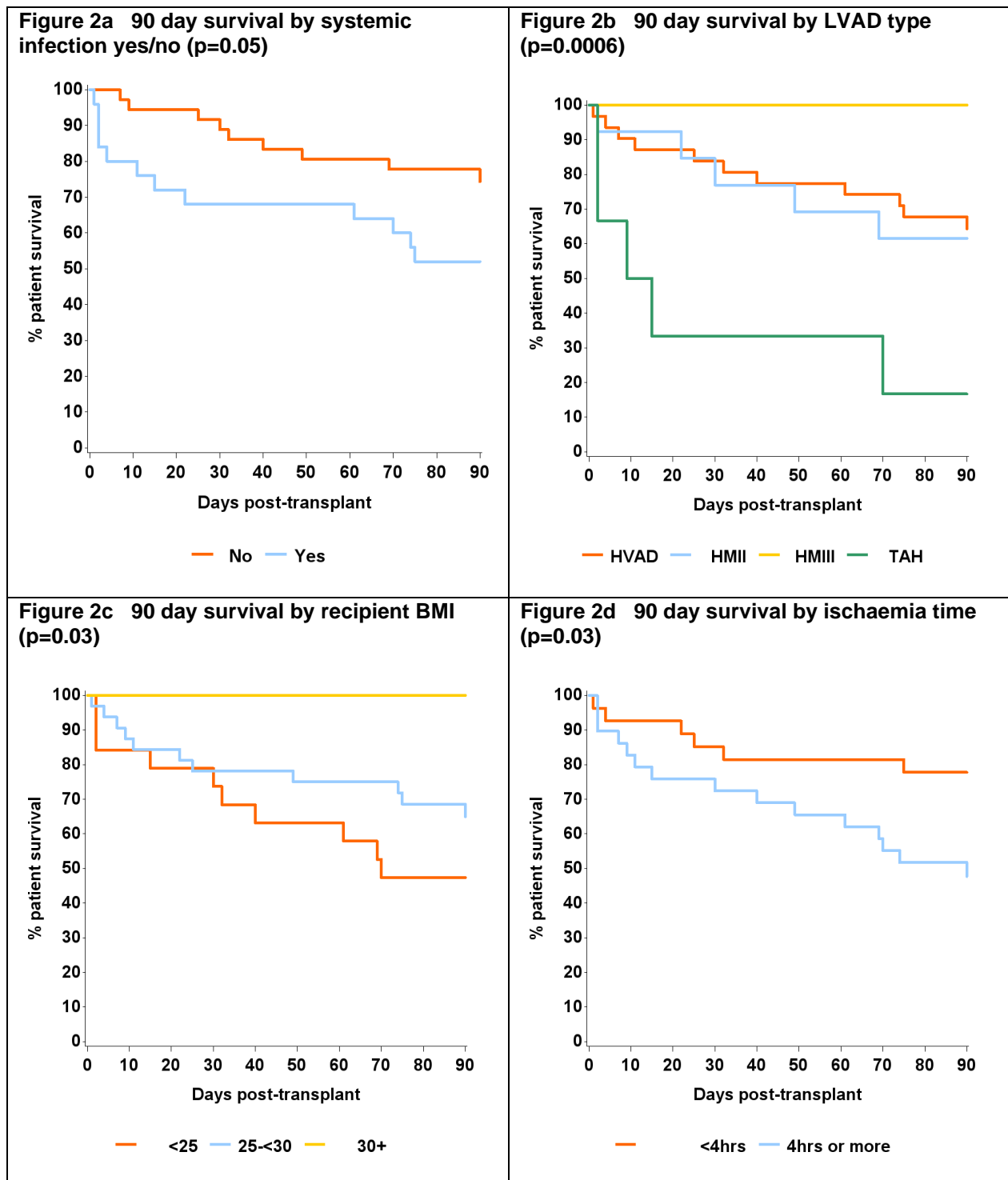
Table 1 Examining impact of variables on 90 day survival of urgent patients transplanted due to LVAD-related complications

| Variable | Died within 90 days N=21 | | Alive at 90 days ¹ N=40 | | Log-rank p-value |
|---|-----------------------------|----|---------------------------------------|-----|---------------------|
| <i>Presence of complication</i> | | | | | |
| Systemic infection (see Figure 2a) | 12 | 48 | 13 | 52 | 0.0456 |
| Driveline infection | 6 | 26 | 17 | 74 | 0.2195 |
| Thrombosis | 2 | 29 | 5 | 71 | 0.6740 |
| Right heart failure | 2 | 18 | 9 | 82 | 0.2337 |
| <i>Type of LVAD (see Figure 2b)</i> | | | | | |
| Heartware (HVAD) | 11 | 35 | 20 | 65 | |
| Heartmate II | 5 | 38 | 8 | 62 | |
| Heartmate III | 0 | - | 11 | 100 | |
| TAH | 5 | 83 | 1 | 17 | 0.0006 |
| <i>More than one VAD/TAH</i> | | | | | |
| No | 15 | 33 | 31 | 67 | |
| Yes (LVAD replaced/Centrimag with LVAD/TAH) | 6 | 40 | 9 | 60 | 0.5111 |
| <i>VAD duration</i> | | | | | |
| <1 year | 4 | 36 | 7 | 64 | |
| 1 year or more | 17 | 34 | 33 | 66 | 0.8129 |
| <i>Stroke</i> | | | | | |
| No | 16 | 32 | 34 | 68 | |
| Yes | 5 | 50 | 5 | 50 | 0.3426 |
| Missing | 0 | - | 1 | 100 | |
| <i>GFR group</i> | | | | | |
| 90ml/min or more | 9 | 31 | 20 | 69 | |
| 60-89 ml/min | 8 | 44 | 10 | 56 | |
| 59 ml/min or less | 4 | 29 | 10 | 71 | 0.6179 |
| <i>BMI (see Figure 2c)</i> | | | | | |
| <25 | 10 | 53 | 9 | 47 | |
| 25-<30 | 11 | 34 | 21 | 66 | |
| 30 or more | 0 | - | 10 | 100 | 0.0264 |
| <i>pHM % difference</i> | | | | | |
| <10% | 14 | 41 | 20 | 59 | |
| 10% or more | 7 | 26 | 20 | 74 | 0.2178 |
| <i>Ischaemia time (see Figure 2d)</i> | | | | | |
| <4 hours | 6 | 22 | 21 | 78 | |
| 4 hours or more | 15 | 52 | 14 | 48 | 0.0303 |
| Missing | 0 | - | 5 | 100 | |
| <i>Centre</i> | | | | | |
| Centre A | 12 | 71 | 5 | 29 | |
| Centre B | 3 | 23 | 10 | 77 | |
| Centre C | 4 | 33 | 8 | 67 | |
| Centre D | 1 | 10 | 9 | 90 | |
| Centre E&F | 1 | 11 | 8 | 89 | 0.0009 |
| Recipient age, median (IQR) | 51 (17-70) | | 46.5 (16-65) | | 0.8999 ² |

¹ For 7 patients survival times were less than 90 days (74-89 days)² Likelihood ratio test from Cox model fitted with age as explanatory variable

8. **Figure 2** displays the unadjusted Kaplan-Meier survival curves for the variables that were found to be significantly associated with 90 day survival.

Figure 2 90 day survival of patients who received an urgent heart transplant for LVAD complications, stratified by significant variables



Results excluding TAH recipients

9. **Figure 9** presents the overall survival excluding those who received a TAH. The 90 day survival rate was 70.5% (95% CI: 56.3-80.8). The variables displayed in Table 1 were tested in this reduced cohort and only three showed a significant association with 90 day survival; these are displayed in **Table 2**. The survival curves stratified by two of the variables are shown in **Figure 4**.

Figure 4 90 day survival of patients who received an urgent heart transplant for LVAD complications excluding TAH

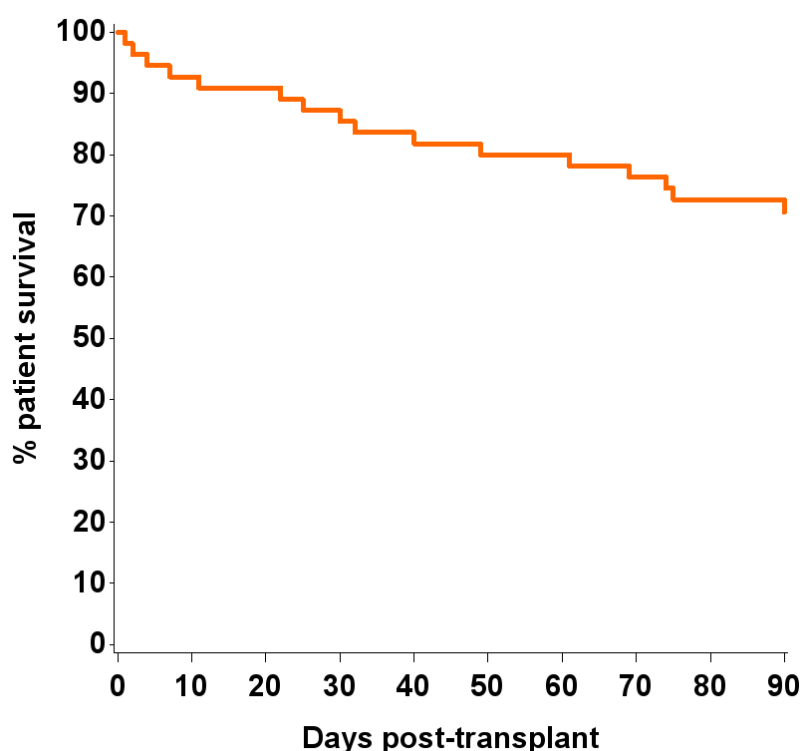
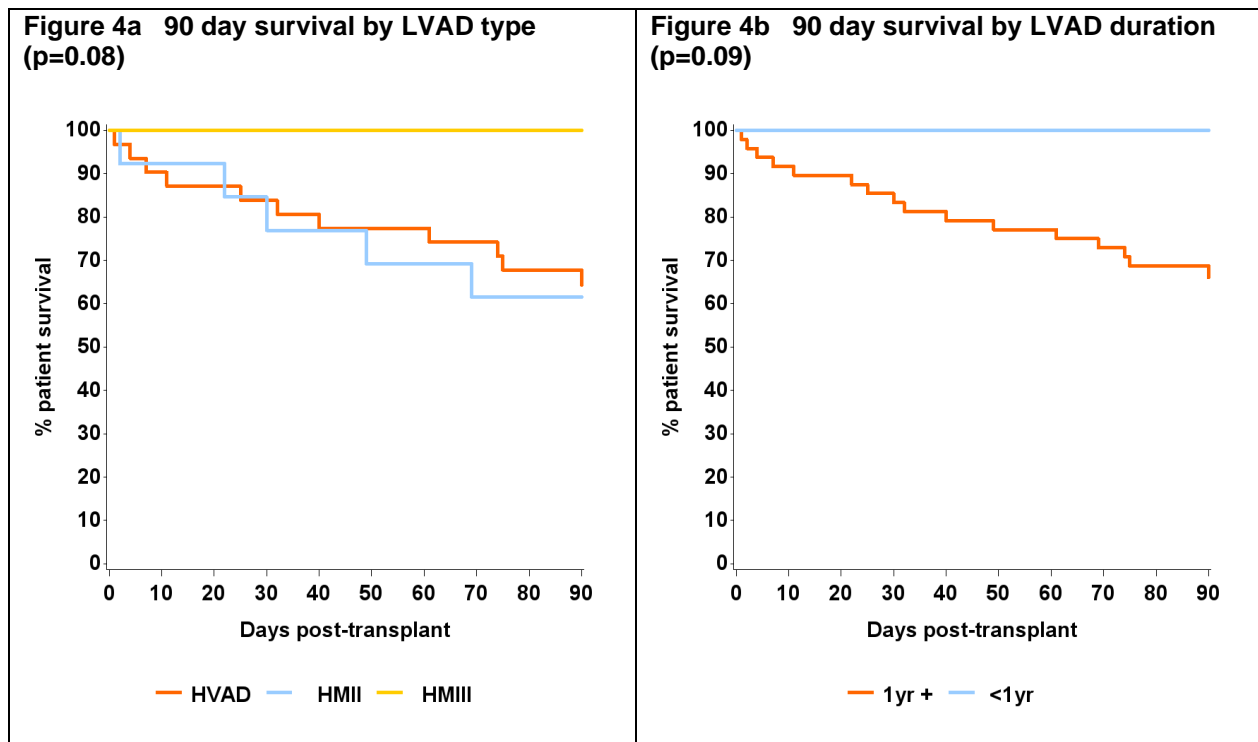


Table 2 Impact of significant variables on 90 day survival of urgent patients transplanted due to LVAD-related complications, excluding TAH

| Variable | Died within 90 days N=21 | | Alive at 90 days ¹ N=40 | | Log-rank p-value |
|--------------------------------------|-----------------------------|----|---------------------------------------|-----|------------------|
| | N | % | N | % | |
| <i>Type of LVAD (see Figure 4a)</i> | | | | | |
| Heartware (HVAD) | 11 | 35 | 20 | 65 | 0.0838 |
| Heartmate II | 5 | 38 | 8 | 62 | |
| Heartmate III | 0 | - | 11 | 100 | |
| <i>LVAD duration (see Figure 4b)</i> | | | | | |
| <1 year | 0 | - | 7 | 100 | 0.0906 |
| 1 year or more | 16 | 33 | 32 | 67 | |
| <i>Centre</i> | | | | | |
| Centre A | 7 | 64 | 4 | 36 | 0.0259 |
| Centre B | 3 | 23 | 10 | 77 | |
| Centre C | 4 | 33 | 8 | 67 | |
| Centre D | 1 | 10 | 9 | 90 | |
| Centre E&F | 1 | 11 | 8 | 89 | |

¹ For 7 patients survival times were less than 90 days (74-89 days)

Figure 4 90 day survival of patients who received an urgent heart transplant for LVAD complications, excluding TAH, stratified by significant variables



CONCLUSIONS

10. In a cohort of 61 patients who received an urgent heart transplant due to LVAD-related complications, the survival at 90 days was 65.2% (lower than the 88.3% presented in the Annual Cardiothoracic Report). Poorer survival was associated with presence of systemic infection, the type of LVAD, recipient BMI, centre and ischaemia time, however some of these factors were highly correlated with each other and may represent unmeasured effects.
11. Patients who received a TAH had particularly poor outcomes. After removing these recipients from the cohort, the survival rate at 90 days was 70.5%. Three variables were associated with poorer survival: LVAD type, LVAD duration and centre.
12. This analysis should be interpreted with caution due to the small sample size and unadjusted nature of the tests.

Sally Rushton
 Statistics and Clinical Research

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