M yxomatous mitral valve disease (MMVD) is the most common cardiac cause of canine morbidity and mortality, accounting for over 70% of cases,\(^1,2\) with a lifetime incidence approaching 100% in some breeds.\(^2\)

Treatment of canine MMVD, once in American College of Veterinary Internal Medicine (ACVIM) stage C of disease, typically consists of palliative medical therapy.\(^3\) Despite advances in medical therapy in recent years, median survival time is still < 1 year from the first episode of congestive heart failure.\(^4\)

In recent years, successful surgical repair of the mitral valve in dogs with MMVD has been reported.\(^5-8\) Surgical repair consists of a partial circumferential mitral annuloplasty and placement of artificial chordae tendinae using Gore-Tex suture material and is performed under cardiopulmonary bypass. The aim is to substantially reduce the amount of mitral regurgitation, which, if successful, allows discontinuation of preoperative diuretic therapy, resolution of clinical signs, extended survival time compared to medical management, and significant improvement in quality of life (QoL).\(^5,6\)

Currently, most papers describing outcomes of dogs undergoing mitral valve repair (MVR) predominantly center around objective clinical data, such as mortality and complication rates and changes in echocardiographic assessment\(^5,7-9\) with a single recent paper\(^6\) reporting the effect of surgery on the QoL of surgical candidates.

**OBJECTIVE**
To determine quality-of-life changes in owners of dogs undergoing mitral valve repair for myxomatous mitral valve disease, up to 12 months postoperatively.

**SAMPLE**
Owners of 26 dogs undergoing mitral valve repair at a single UK veterinary referral hospital.

**METHODS**
Dogs underwent mitral valve repair under cardiopulmonary bypass as previously described. Owner quality of life was assessed by self-completion of a previously validated questionnaire preoperatively and at 1, 3, 6, and 12 months postoperatively.

**RESULTS**
There was a statistically significant improvement in quality-of-life scores from preoperatively up to 3 months postoperatively and a statistically significant improvement in individual question scores up to 6 months postoperatively.

**CLINICAL RELEVANCE**
Results suggested that owner quality of life is significantly improved following surgical repair of their pet’s myxomatous mitral valve disease, and this improvement continues beyond the immediate postoperative period. These results may be useful when counseling owners of surgical candidates and is another useful outcome measure.

**Keywords:** cardiopulmonary bypass, cardiac surgery, myxomatous mitral valve disease, cardiothoracic surgery, mitral valve repair

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Assessment of QoL is now a commonly utilized marker of procedural success in human medicine. While the majority of QoL research within the human field focuses on patient experiences, it has been shown that carers of patients can also experience adverse physical, psychological, social, and financial consequences (ie, the so-called caregiver burden).\textsuperscript{13} Parents of children with congenital heart disease are demonstrated to be at increased risk of feelings of distress, hopelessness, isolation, and suicide ideation, with up to 30% reporting symptoms consistent with posttraumatic stress disorder.\textsuperscript{11,12}

In veterinary medicine, there is currently limited research into the impact on QoL of owners caring for chronically ill pets. One study\textsuperscript{13} of 238 owners of companion animals with chronic or terminal disease reported significantly higher levels of stress, symptoms of depression and anxiety, and poorer QoL compared to owners of healthy control animals. Studies\textsuperscript{14,15} of canine and feline diabetes have demonstrated that the majority of owners felt the disease had a greater impact on their own QoL than that of their pet, and in 1 study\textsuperscript{16} of owners of dogs with atopic dermatitis, 48% reported the disease had a negative impact on their own QoL.

The effect of canine cardiac disease on owners’ QoL has also been recently investigated, with a questionnaire being validated specifically for this purpose (including a later extended version).\textsuperscript{17,18} These studies demonstrated that QoL is significantly reduced in caregivers of dogs with cardiac disease, with 47% of owners reporting that worries about caring for their pets were sometimes or often overwhelming.\textsuperscript{18} Both studies reported results from owners of dogs with a range of cardiac disease, with MMVD the most common condition in both cohorts. In both of these studies, OQoL was demonstrated to be at increased risk of feelings of distress, hopelessness, isolation, and suicide ideation, with up to 30% reporting symptoms consistent with posttraumatic stress disorder.\textsuperscript{11,12}

MVR surgery involves substantial financial and temporal commitment from owners, as well as being associated with a significant degree of risk to their pets. Therefore, careful consideration of the risks and benefits is required by both the owner and the veterinary teams involved in the case. Given this, reporting outcomes of previous surgical candidates is crucial to assist all parties with the decision-making process. While QoL in dogs undergoing MVR has been shown to significantly improve following MVR,\textsuperscript{6} the impact of surgical management of canine MMVD on OQoL has not previously been investigated. The objective of this study, therefore, was to determine changes in OQoL scores before and after their dogs underwent MVR. We hypothesized that, within 1 month postoperatively, owners of dogs that had undergone MVR would have a significant improvement in their QoL.

### Methods

All owners of dogs undergoing MVR to treat MMVD at The Queen Mother Hospital for Animals, Royal Veterinary College, London, between April 2019 and January 2020 were invited to participate in this study and enrolled if informed consent was given. Institutional ethical approval for the study was obtained.

OQoL was assessed by means of a questionnaire previously validated by Tufts University for the purpose of assessing health-related QoL in owners of dogs with cardiac disease.\textsuperscript{17} This questionnaire was used with the authors’ prior approval.

The questionnaire was replicated into a digital copy. Owners were asked to complete a digital copy of the questionnaire at their preoperative visit, within 1 week prior to MVR surgery, and then again at 1, 3, 6, and 12 months postoperatively. The time points assessed were summarized (Table 1): these time points are consistent with scheduled re-examinations after MVR surgery. When follow-up examinations were performed at a different institution, the digital questionnaire was emailed to clients at the appropriate time points. Participants were excluded if their pet died prior to discharge from the hospital or during the 12-month study period or if a questionnaire was not completed preoperatively or not completed at least once between 1 and 12 months postoperatively.

The questionnaire is composed of 7 questions on the impact of specific factors on QoL over the 7 days prior to questionnaire completion (Table 2).

### Table 1—Questionnaire completion intervals.

<table>
<thead>
<tr>
<th>Time point</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>T₀</td>
<td>Prior to surgery</td>
</tr>
<tr>
<td>T₁</td>
<td>1 month postoperatively</td>
</tr>
<tr>
<td>T₂</td>
<td>2 months postoperatively</td>
</tr>
<tr>
<td>T₃</td>
<td>6 months postoperatively</td>
</tr>
<tr>
<td>T₄</td>
<td>12 months postoperatively</td>
</tr>
</tbody>
</table>

### Table 2—Questionnaire covering owners’ quality of life.

<table>
<thead>
<tr>
<th>Question No.</th>
<th>How much did your dog’s heart disease negatively impact your lifestyle during the last 7 days by</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Disrupting your sleep habits (because of your dog’s restlessness or need to go outside)</td>
</tr>
<tr>
<td>2</td>
<td>Making you reluctant to leave home for social activities or vacations</td>
</tr>
<tr>
<td>3</td>
<td>Causing problems due to excessive urination</td>
</tr>
<tr>
<td>4</td>
<td>Affecting your work schedule</td>
</tr>
<tr>
<td>5</td>
<td>Causing problems with giving medications (either difficulty in administration or difficulty with medication regimen)</td>
</tr>
<tr>
<td>6</td>
<td>Creating burdensome costs for medical care</td>
</tr>
<tr>
<td>7</td>
<td>Making you worry about your dog’s condition</td>
</tr>
</tbody>
</table>
Each question is scored on a Likert scale ranging from 0 (no impact of factor on OQoL) to 5 (OQoL very much affected by factor) to give a total questionnaire score of 0 to 35, with a higher score indicating a greater negative impact on OQoL.

Owners were additionally asked to complete the Functional Evaluation of Cardiac Health Questionnaire, providing an assessment of their dogs’ QoL; findings are reported in a separate study.

Questionnaire data, in addition to dog signalment and ACVIM disease stage details, were entered into Excel (Microsoft Corp).

**Statistical analysis**

Data were analyzed with SPSS, version 24 (IBM), with significance set at $P < .05$. Variables were assessed for normality with a Shapiro-Wilk test. Normally distributed data are reported as mean and SD, and nonparametric data are reported as median and range. Descriptive analysis was used for signalment and disease stage.

### Table 3—Median scores at each questionnaire time point.

<table>
<thead>
<tr>
<th>Time point</th>
<th>No. of questionnaires completed</th>
<th>Median score</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>$T_0$</td>
<td>26</td>
<td>25.5</td>
<td>1–35</td>
</tr>
<tr>
<td>$T_1$</td>
<td>25</td>
<td>6</td>
<td>0–32</td>
</tr>
<tr>
<td>$T_3$</td>
<td>24</td>
<td>2.5</td>
<td>0–22</td>
</tr>
<tr>
<td>$T_6$</td>
<td>25</td>
<td>2</td>
<td>0–18</td>
</tr>
<tr>
<td>$T_{12}$</td>
<td>21</td>
<td>1</td>
<td>0–14</td>
</tr>
</tbody>
</table>

### Table 4—Cases included in each analysis.

<table>
<thead>
<tr>
<th>Time points compared</th>
<th>No. of dogs (out of 26)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$T_0$ and $T_1$</td>
<td>25 (96.2%)</td>
</tr>
<tr>
<td>$T_1$ and $T_3$</td>
<td>24 (92.3%)</td>
</tr>
<tr>
<td>$T_3$ and $T_6$</td>
<td>24 (92.3%)</td>
</tr>
<tr>
<td>$T_6$ and $T_{12}$</td>
<td>21 (80.8%)</td>
</tr>
</tbody>
</table>

### Table 5—Score changes between time points.

<table>
<thead>
<tr>
<th>Question</th>
<th>$P$ value</th>
<th>$T_0$ and $T_1$</th>
<th>$T_1$ and $T_3$</th>
<th>$T_3$ and $T_6$</th>
<th>$T_6$ and $T_{12}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (sleep)</td>
<td>.152</td>
<td></td>
<td>.010</td>
<td>.007</td>
<td>.124</td>
</tr>
<tr>
<td>2 (social)</td>
<td>.035</td>
<td>.029</td>
<td>.02</td>
<td>.06</td>
<td></td>
</tr>
<tr>
<td>3 (urination)</td>
<td>.213</td>
<td>.364</td>
<td>.287</td>
<td>.382</td>
<td></td>
</tr>
<tr>
<td>4 (work)</td>
<td>.073</td>
<td>.113</td>
<td>.099</td>
<td>.35</td>
<td></td>
</tr>
<tr>
<td>5 (medications)</td>
<td>.001</td>
<td>.006</td>
<td>.311</td>
<td>.12</td>
<td></td>
</tr>
<tr>
<td>6 (costs)</td>
<td>&lt; .001</td>
<td>&lt; .001</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 (worry)</td>
<td>.109</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

— = Incalculable because input values are constant. Significant values in bold.

**Results**

### Signalment

The owners of 30 dogs undergoing MVR during the study period met the inclusion criteria. Four were excluded because they died prior to discharge from the hospital. No dogs died after discharge from the hospital, and therefore the remaining 26 dogs were all alive at the time of the study’s conclusion (12 months postoperatively). Mean age of dogs in the study population was 10.5 years (SD, 1.89). There were 12 (46.2%) neutered males, 8 (30.8%) neutered females, 4 (15.4%) entire females, and 2 (7.7%) entire males. The most common breeds were Cavalier King Charles Spaniels and Chihuahuas, accounting for 19.2% and 14.4% of the population respectively.

Twenty dogs (76.9%) were in ACVIM stage C of disease, and 6 dogs (23.1%) in ACVIM stage D.

### Questionnaires

The median score at each questionnaire time point was summarized (Table 3). Total scores were compared between each time point. The number of cases included in each analysis was summarized (Table 4).

Total scores decreased between each time point. This was statistically significant when comparing $T_0$ and $T_1$ ($P < .001$) and $T_1$ and $T_3$ ($P = .002$) but was not significant when comparing scores between $T_3$ and $T_6$ ($P = .11$) or $T_6$ and $T_{12}$ ($P = .94$).

Results of mean scores for individual questions at each time point were summarized (Figure 1).

Results of score changes for individual questions at each time point were summarized (Table 5).

Three individual questions (out of 7) showed a statistically significant reduction in scores between $T_0$ and $T_1$, 4 between $T_1$ and $T_3$, and 4 between $T_3$ and $T_6$. Changes in scores between $T_6$ and $T_{12}$ were not statistically significant for any question.
Stage of disease

Scores for each question as well as total scores were compared at each time point for owners of dogs in ACVIM stage C versus stage D of MMVD. Total scores were significantly higher (indicating a worse impact on OQoL) at T₀ (P = .034) for dogs in stage D versus stage C but not at the other time points. Mean scores were significantly higher at T₀ for stage D versus stage C dogs for question 1 (P = .001), question 2 (P = .003), and question 4 (P = .008). Mean scores for individual questions were not significantly different between dogs in stage D versus stage C at any time point postoperatively (P > .50).

Discussion

This is the first study to document the impact of canine MVR on OQoL and the first report in the veterinary literature to assess OQoL following a surgical intervention. We found a statistically significant decrease in total scores (improvement in OQoL) from preoperatively up to 3 months postoperatively, and statistically significant decreases in scores for individual questions up to 6 months postoperatively. These findings indicated that a significant improvement in OQoL following MVR and that the potential for improvement of OQoL following canine MVR extends beyond the initial postoperative period, with the associated benefits seen in many facets of life.

Freeman et al²⁰ reported the results of an extended 20-item questionnaire completed by owners of 141 dogs with cardiac disease, 86% of which had been diagnosed with MMVD. That study demonstrated a significant association between OQoL scores and ACVIM stage, which corresponds to our results at T₀. It is interesting to note that by 1 month postoperatively, there was no statistically significant difference in total or individual question scores between owners of dogs with preoperative stage C or D disease and that scores remained statistically similar throughout the postoperative period between initial ACVIM stages of disease. This finding is useful when considering surgical management of dogs in ACVIM stage D of disease; however, the finding must be considered in light of the increased mortality rate during hospitalization of dogs in stage D versus those at earlier stages of disease.²⁰

When individual questions were compared, both absolute values and temporal trends varied. This finding indicated that certain areas of owners’ lives are more susceptible to disruption by their pets’ heart disease than others, and that improvement in OQoL following MVR does not progress consistently across all areas. Total scores significantly decreased between T₀ and T₁ and between T₁ and T₃, but not beyond this time point. Typically, the protocol following MVR at this hospital includes more extensive exercise restriction and administration of anticoagulant therapy until T₃; therefore, for many of the owners in this study, T₁ would be the time point their pet could return to the normal routine that they had enjoyed prior to the onset of clinical signs of heart disease, which may account for our findings.

There was a statistically significant improvement in the impact of medication administration on OQoL between T₀ and T₃, but no further significant improvement was seen after T₁. At this hospital, following successful MVR, all diuretic medications are discontinued immediately postoperatively, with only aspirin, clopidogrel, and pimobendan prescribed, the latter being discontinued in most dogs between T₁ and T₃, and anticoagulant therapy is discontinued at T₃. It is therefore interesting that there is no significant change between T₁ and T₃, indicating that owners may find administration of anticoagulant therapy less stressful than administration of cardiac medication, or perhaps that anticipated suspension of all treatment at T₃ reduces anxiety around medications compared to more immediately postoperatively.

The impact of financial stress on OQoL showed a statistically significant improvement between all time points up to T₆. This is unsurprising given the expense associated with MVR surgery and the associated specialist monitoring required postoperatively. It is not possible to determine whether financial stress returned to normal levels after T₆; however, no further significant improvement was noted, and the median score of owners who returned a questionnaire at T₁₂ was 0 for this question. Follow-up consultations with a cardiologist typically occurred at 1, 3, 6, and 12 months postoperatively and then on an annual basis, which correlates with the time frame of reported reduction in financial stress. Freeman et al²⁰ noted that cost and medication issues were not as strongly correlated to total score as other aspects; this likely reflects the differing population, with the majority of dogs in Freeman et al’s study receiving comparatively minimal intervention.

Freeman et al²⁰ reported that worry about their pet, reluctance to leave home for social activities, and disrupted sleep were the questions most strongly correlated to total score. In our study, these questions had the highest average scores at T₀, suggesting that although OQoL is further depressed as disease stage advances, the etiology of this impairment remains consistent. In our study, the impact of reluctance to partake in social activities on OQoL significantly decreased at all time points from T₀ to T₆. Interestingly, a significant decrease in the other 2 questions (sleep disruption and worry about their pets’ condition) on OQoL was not seen between T₀ and T₁, though significant changes were seen between T₁ to T₃ and T₃ to T₆. This implies that successful MVR did significantly alleviate the major contributing factors of caregiver burden found by Freeman et al²⁰ and in this population, but that this effect was not immediate. For many of the owners within this study, the distance between their home location and the hospital necessitated that they stay in local accommodation for a period following discharge (usually around 2 weeks postoperatively), prior to their dog being deemed fit for air travel. For these owners, the T₁ time point typically occurred shortly after returning home, which may explain the lack of improvement in generalized worry and sleep disruption until the T₆-to-T₉ period. This could also be an indicator of how long it takes the average owner to start to relax after their
pet undergoes a major surgery. As there are no other veterinary studies on QoL following a surgical intervention, we can only speculate at this time.

Total scores at T3 ranged from 1 to 35 out of a maximum 35, with a median of 25.5. This range likely reflects differences both in the population of dogs and in the owners themselves. A systematic review of caregiver burden in human medicine found that patient factors, such as the level of symptoms experienced, did increase caregiver burden, but the main risk factors for a high burden not only included those related to patients but also were heavily influenced by the caregiver themselves, particularly in relation to sociodemographic factors (income, gender, educational level, level of social support) and psychological factors (psychological health, depressive symptoms, and anxiety).21 No information was collected regarding owner risk factors for caregiver burden in this study; therefore, we cannot determine the impact of caregiver factors on QoL scores, but this is an area that warrants further research in the future.

This study had several limitations. First, the sample size is small, and our response rate throughout the study period, while good compared to average survey response rates,22 was not 100%; therefore, it is possible a response selection bias occurred. Owners of dogs that did not survive to hospital discharge were excluded from this study; consequently, the impact of surgical mortality on QoL is not quantified, and this must be considered if these data are used as a factor when practitioners advise owners of potential surgical candidates. Finally, within this study, owners acted as their own controls, limiting introduction of confounding factors; however, this means that we cannot easily make conclusions about the QoL of the population of owners within our study versus owners of dogs with medically managed cardiac disease. For example, while we demonstrated reduction in both worry and financial concerns within our population, it is not known whether preoperative scores were elevated because of the impending surgery. Further work comparing owners of dogs undergoing MVR to those receiving medical therapy is indicated. Other work in this area may include use of the expanded questionnaire developed by Freeman et al,28 to allow more accurate determination of areas of life where QoL improvement may be expected or to indicate areas where clinical intervention should be directed.

In conclusion, our results demonstrate that successful MVR can significantly reduce caregiver burden in owners of dogs with MMVD and that this benefit extends beyond the immediate postoperative period, being sustained in the long term (up to month 12 in this study). These results may aid owner decision-making when considering treatment modalities for surgical candidates and add to objective quantification as a marker of success following canine MVR.

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Disclosures

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