Canine Cardiopulmonary Bypass:
Mitral Valve Annuloplasty and Artificial Chordal Replacement on Extracorporeal Circulatory Bypass
'The Peri-operative and Post-operative Nursing Care Case Report'

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Introduction

Myxomatous mitral valve disease (MMVD), mitral regurgitation and the far too common sequalae of chordae tendineae rupture, accounts for an overall 75 – 80% of cardiac related diseases in the canine population (Mizuno et al., 2013). Whilst medical management has been evidential in augmenting cardiac insufficiencies and cultivating an overall improvement in quality of life, 80% of these patients will survive no longer than 2-years post diagnosis (Häggström et al., 2008). The medium life longevity of cases with severe MMVD and chordae tendineae rupture stands at only 6 – 7 months (Serres et al., 2007).

Where the dynamics in medical convalescence and pharmaceutical management have often proved challenging with a negligible benefit on prognosis. The surgical advancements on repairing degenerative mitral valves via the means of a circumferential annuloplasty and chordal replacement have been proposed (Uechi et al., 2012). There are currently only three specialist centres worldwide that are pioneering these surgical advancements in small animal veterinary medicine, and where post-operative outcomes on quality of life have been significantly improved (Pennington et al., 2020).

Case Presentation

A 9-Year, 4-Month-old, Male-Entire, Cavalier King Charles Spaniel, weighing 9.20Kg, presented to the Cardiothoracic Surgery Service for surgical repair of his progressive and incurable Stage-D MMVD (*American College of Veterinary Internal Medicine (ACVIM), Consensus Statement 2019).*

Physical Examination: Grade 5/6 left-sided apical systolic murmur with synchronous pulses and regular sinus rhythm. Focal crackles in the right caudal lung fields despite concurrent aggressive dieresis therapy. Non-invasive blood pressure noted hypertension @ 170mmHg.

Thoracic Radiographs: Severe generalised cardiomegaly, severe left atrial enlargement, dorsal deviation of the trachea and compression of the mainstem bronchus. Mild interstitial pattern also present in right caudo-dorsal lung field, representative of mild pulmonary oedema.

Echocardiography: Advanced mitral valve endocarditis: Severe mitral thickening with prolapse and flail leaflets. Torrential posteriorly directed mitral regurgitation. Severe left atrial and left ventricular enlargement. Thickened tricuspid valve with regurgitation. Pulmonary hypertension.

Pre-Surgical Care Bundle

The Royal Veterinary College algorithm for pre-surgical assessment criterions when evaluating patient's suitability for Open-Heart Surgery:

- Collate Full Medical History, Diagnostic Reports and Referral Letters
- Multidisciplinary Case Discussion Rounds to Assess Patient Suitability
- Complete Blood Count, Biochemistry, Urine Culture and Blood Typing
- Final Pre-Surgical Consultation and Echocardiogram
- Informed Consent Obtained and Patient Admission for Surgery

The Peri-Operative Period

All Heart Surgery Patients are Barrier Nursed to reduce the risk of Hospital Acquired Infections

Induction:
- Pre-Medication: Methadone 0.2mg/kg IV
- Co-Induction: Propofol 2.2mg/kg & Midazolam 0.5mg/kg IV
- Intubation: 6.5mm Cuffed Endotracheal Tube
- Maintenance Inhalational Volatile Agent: Sevoflurane

Surgical Preparation:
- Left Lateral Intercostal and Bilateral Ventrolateral Cervical Regional Hair Clip and Initial Skin Preparation (No:40 Blade, 0.25mm Hair Clip and Chlorhexidine 4% 50:50 Dilution)
- Placement of Jugular Central Venous Catheter and Dorsal Metatarsal Arterial Cannula
- Placement of Foley Catheter and Urinary Collection System
- Loco-regional Paravertebral Block, Bupivacaine 2mg/kg
- Transfer to Theatre: Positioned in Right Lateral Recumbency, Final Skin Preparation (ChloraPrep™ 2% CHG / 70% IPA solution), Sterile Draping of Surgical Fields
- Transesophageal Echocardiogram

Surgical Procedure:
- Left 5th Intercostal Thoracotomy
- Left Cervical Isolation of the Carotid Artery for Cannulation
- Patient Heparinised: Initial 300iu/kg, Consecutive Doses 100iu/kg
- Placement of Aortic Root Cannula
- Placement of Venous Cannula into Right Atrium (Venous Reservoir Return)
- Transition onto Cardiopulmonary Bypass (CPB)
- Patient Core Body Temperature Cooled to 28°C
- Delivery of Cardioplegia Solution until Asystole
- Mitral Valve Accessed via Left Atriotomy
- Artificial Chordal Replacement (Gore-Tex Sutures): x3 Located Between the Papillary Muscles and Edge of S2 Valve Leaflet and x2 on M2 Valve Leaflet.
- Deep Fissure Closure between M1 and M2 Leaflets (Polypropylene 6/0)
- Circumferential Suture Annuloplasty (Gore-Tex Sutures) and Pledget's (Gore-Tex Patch)
- Repeat Transesophageal Echocardiogram
- Patient Core Body Temperature Warmed to 36°C
- Delivery of 'Hot-Shot' to Initiate Return of Spontaneous Circulation (ROSC)
- Administration of Protamine Sulphate: Achieve Normal Activated Clotting Times (ACT)
- Removal of Aortic Root Cannula, Carotid Cannula and Venous Line: CPB Terminated
- Closure of Thorax and Cervical Regions

Post-Operative Period:

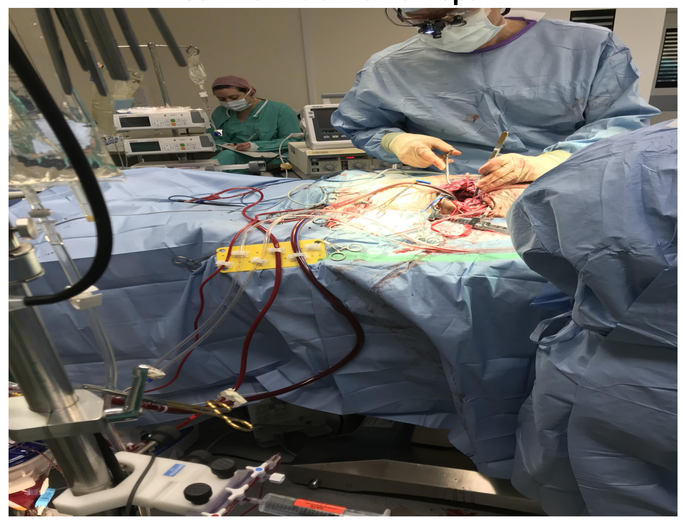
Day 1
- Patient Transitioned into Intensive Care for Recovery
- Instrumented with Continuous Multiparameter Monitoring
- Oxygen Therapy Commenced @ FiO2 60 – 80%
- Continuation of Fentanyl CRI, +/- Dobutamine and Lidocaine CRI's
- Continuation of Blood Products: Packed Red Blood Cells (PRBC's) and Fresh Frozen Plasma (FFP)
- Initial Hourly Monitoring of Thoracic Drain Output, Urinary Output and Arterial Blood Gas Evaluation
- Once Stabilised: Serial Monitoring of Values Reduced to Q4 Hourly
- Commencement of Low Molecular Weight Heparin (Days 1 – 10)

Days 2 – 3
- Patient De-Instrumented from Multiparameter Monitoring
- Removal of Thoracic Drain, Central Venous, Arterial and Urinary Catheters
- Analgesia Protocol De-escalated to Q4 Hourly Methadone
- Commencement of Oral Antifibrinolytic Medications
- Daily Exercise (Minimal) Incorporated with Nursing Care Plan
- Repeat Echocardiogram Evaluation
- +/- Discontinuation of Diuretics, Aldosterone-mediators, ACE Inhibitors and Antiarrhythmics

Days 4 – 10
- Patient Transferred into Soft Tissue Surgery Ward for ongoing Post-Operative Care
- Continuation of Oral Inotropic Medication (Pimobendan) and Antifibrinolytics.

Discharge:
- Repeat Check-up's: 1-Month, 3-Months, 6-Months, 12-Months and then Annually
- Most Patients Discontinue all Medications Once Sufficient Cardiac Remodelling Occurs

Canine Mitral Valve Repair



Individual Patient Considerations

- **Analgesia:** Fentanyl CRI, Intra-Pleural Bupivacaine and Loco-regional Paravertebral Blockades (Day 1), Methadone (Days 2-3), Buprenorphine (Days 4-7)
- **Cardiovascular:** Arrythmias, Circulatory Volume, Haemorrhage vs Thrombolytic Events
- **Respiratory:** Desired PaO2 >80mmHg, PaO2:FiO2 Ratio >400, or A:a Gradient <15
- **Metabolic:** Electrolyte Derangements and Post-CPB Inflammatory Processes
- **Anti-Thrombotic Therapy:** LMW Heparin, Aspirin and Clopidogrel
- **Fluid Therapy:** Isotonic Crystalloids +/- KCL Supplementation
- **Colloidal Support:** Packed Red Blood Cells and Fresh Frozen Plasma Transfusions
- **Indwelling Devices:** Thoracic Drain, Jugular Central Venous Catheter, Arterial Catheter, Central Venous Pressure, Urinary Catheter, and +/- External Pacing Requirements
- **Nutrition:** PRN (Parenteral & Enteral Nutrition Techniques Typically Not Required)
- **Exercise:** Harness Walks Only, <5-minute Intervals, 3-4 Times Daily

Conclusion

The post-operative intensity on intervention, physiological considerations, and delivery of nursing care of such complex cases is undoubtfully advantageous on survival to discharge. The nurse's role in advocating a multi-disciplinary care plan encompassing an holistic approach within the execution of nursing care and underpinning recognition to the enormity of these patients multiorgan physiological requirements is paramount to the existence of propitious outcomes.

At the time of discharge, this patients cardiac murmur had reverted back to a Grade 1/6 apical systolic murmur and was evaluated as Stage-B2 MMVD on echocardiogram.

Acknowledgements and References

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