

Laparoscopic Cholecystectomy for Children with Repaired Tetralogy of Fallot with Valve Replacement on Anticoagulant: A Case Report and Anticoagulant Management

Mridu Paban Nath^{1*}, Rajib Bhattacharyya² and Malavika Barman³

¹Department of Anaesthesiology and Critical Care, Gauhati Medical College Hospital, Guwahati, Assam, India

²Department of Anaesthesiology and Critical Care, FAAMC, Barpeta, Assam, India

³Tezpur Medical College, Tezpur, Assam, India

*Corresponding author: Dr. Mridu Paban Nath, Department of Anaesthesiology and Critical Care, Gauhati Medical College Hospital, Guwahati, Assam-781005, India, Tel: 91-11-9957630954; Email: drmridupaban@yahoo.com

Received: Feb 26, 2014, Accepted: May 9, 2014, Published: May 14, 2014

Copyright: © 2014 Mridu Paban Nath, et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Abstract

A 7 year old boy with a history of repaired tetralogy of Fallot with aortic valve replacement was scheduled to undergo laparoscopic cholecystectomy. His significant history comprises of post cardiac surgery with warfarin anticoagulant. Perioperatively warfarin was converted to low molecular weight heparin and the patient underwent general endotracheal anaesthesia with caudal epidural anaesthesia for laparoscopic cholecystectomy. Anaesthesia induction, intraoperative course and postoperative period proceeded uneventfully and the patient quickly progressed to the preoperative level of functioning. The perioperative anticoagulant management in such patients of repaired tetralogy of Fallot with aortic valve replacement is reviewed.

Keywords: Tetralogy of Fallot (TOF); Laparoscopic cholecystectomy; Warfarin; LMWH

Introduction

Long term survival after surgical correction of tetralogy of Fallot (TOF) has been achieved since the earliest surgical reports of repair and continues in more contemporary reports [1-3]. Most survivors lead symptom free lives with 98% of patients New York Heart Association (NYHA) class-I [1]. Survivors may experience haemodynamic and electrophysiologic residua and sequelae, which include residual right ventricular outflow tract (RVOT) obstruction, right ventricular dilation and dysfunction with pulmonary valve insufficiency related to transannular patching, progressive aortic dilation with development of aortic regurgitation [4]. Such patients after corrective surgery with valve replacement needs lifelong anticoagulant supplement. There is not yet a consensus on the appropriate perioperative management of patients receiving anticoagulants and/or antiplatelet agents who are about to have surgery. Various protocols aimed at minimizing the risk of thromboembolism and bleeding have, however, been proposed. We describe the perioperative anticoagulant management of a patient of corrected TOF with prosthetic aortic valve replacement.

Case Report

A 7 year old boy weighing 25 kg, who was a known case of repaired TOF with Aortic valve replacement (AVR), having cholelithiasis was scheduled for laparoscopic cholecystectomy. His past surgical history comprises of Blalock-Taussig shunt at the age of 3 months of his age and then total correction of TOF with AVR (23 size St. Jude Aortic Valve) with shunt take down at the age of 4 years. After that surgery, he was asymptomatic for cardiac symptoms and on regular follow up with cardiologist.

Perioperatively, patient was reviewed by cardiologist & electrocardiography (ECG) within normal limit. 2-D echocardiography revealed normal functioning prosthetic aortic valve with no residual shunt and normal systolic function of left ventricle. Patients cardiac condition was optimised with addition of Metoprolol 12.5 mg daily and the patient was NYHA-I and afebrile. His cardiac medications include only Warfarin tablet 2 and 3 mg on alternate days to maintain target international normalized ratio (INR) 2-3. His drug compliance and past INR record shows good maintenance. The patient was instructed to stop Warfarin 5 days before surgery and the INR recorded was 2.8 and Low molecular weight heparin (LMWH) Enoxaparin was started empirically 20 mg subcutaneously twice daily to avoid INR drifts below therapeutic range (i.e. INR<2.5). INR repeated on the day before surgery was elevated to 1.6. The last preoperative dose was administered on the morning of the day before the surgery to ensure no residual anticoagulant effect at the time of surgery. The INR was rechecked and was 1.3 on the morning before the day of surgery.

All other laboratory results were within normal limit. The surgical plan was laparoscopic cholecystectomy. Patient was premedicated with Tab Lorazepam 0.5 mg orally 2 hour before shifting to operation theatre (OT). Infective endocarditis prophylaxis was given intravenously with Ampicillin 1500 mg and Gentamycin 40 mg 1 hour before surgery. Upon arrival into the OT, patients' blood pressure recorded was 110/60 mm Hg, heart rate 76/minute and Oxygen saturation 99% on Oxygen via face mask 5 litre/min. A 20 gauze I.V. and right radial arterial cannula established under local anesthetic infiltration. Anesthesia induced with Etomidate 5 mg and Fentanyl 50 µg. Rocuronium bromide 20 mg was used to facilitate the insertion of a cuffed endotracheal tube. Post-induction triple lumen central venous catheter inserted in the right internal jugular vein showed CVP 8 cm of water. After position of the patient on his left lateral position, a

single shot caudal epidural drug administered with 10 ml 0.25% Ropivacaine with 1mg Morphine.

Anesthesia maintained with Isoflurane in Oxygen and air mixture with intermittent doses of Rocuronium. Intraoperatively mean arterial pressure was maintained 60-80 mm Hg, heart rate 70-80 beats/min, CVP 9-12 cm water, Etco₂ was 32-38 mm Hg and airway pressure was 15-18 cm of water. During pneumoperitoneum, maximum intra-abdominal pressure achieved was 11 mm Hg. Arterial blood gases and electrolytes was within normal range and ECG tracings were normal sinus rhythm with occasional premature ventricular ectopics without any ischemic changes. Total duration of surgery was 45 minutes and patient reversed and extubated inside the OT. Overall anesthetic management was uneventful. In the post anesthesia care unit, patient was fully awake with stable vitals.

In the immediate postoperative period, there appears to be adequate hemostasis although there is ongoing drainage of serosanguinous fluid from an abdominal drain, with 50 ml having accumulated within 6 hours after surgical closure. Warfarin is resumed on the evening of the day of surgery, with sips of water, starting with the patient's usual dose for that day of the week. On the 1st postoperative day, low-dose LMWH is administered (i.e., enoxaparin 20 mg once-daily). On the 2nd postoperative day, there is no ongoing blood loss from the intraabdominal drain, and LMWH is increased to full-dose treatment (i.e., enoxaparin 20 mg twice-daily). On the 5th postoperative day, when the INR is 2.5, full-dose LMWH is stopped after the evening dose and continued with warfarin as preoperative dose and discharged on the same day.

Discussion

Current estimates suggest that there are nearly one million adults with congenital heart disease in the United States today and 35,000 babies are born with congenital cardiac defects each year [5]. Only a few decades ago, many congenital cardiac anomalies were fatal in infancy. Now operative repairs are possible in even the most complex anomalies and these infants and children are surviving and growing into adults. Today, approximately 85% of babies born with congenital cardiac anomalies will reach adulthood and long-term survival is expected to continue to improve.

The most frequently seen congenital cardiac lesions in the adult population are ASD/VSD, aortic coarctation, tetralogy of Fallot, and transposition of the great arteries [6]. The majority of these adult patients will have undergone one or several surgical or catheter interventions to correct or palliate their cardiac lesion. 30-year survival rates have been reported at approximately 90% [7]. Most individuals remain in NYHA functional class I or II.

In 2001, the American College of Cardiology published their recommendations regarding health care for adults with congenital heart disease [5,8,9]. Adults with moderate and complex congenital heart disease (CHD) who require non-cardiac surgery have special needs to be addressed by the surgical and anesthesia team. Ideally, operations in patients with complex CHD should be performed at a regional adult congenital heart disease (ACHD) centre with physicians experienced in the care of these individuals and with the consultation of cardiologists trained in this discipline.

The anesthetic management in patients of corrected TOF is not different from other patients. The main concern is the presence of any residual shunt that remains after correction that needs close attention.

So, preoperative echocardiography is routinely performed before any noncardiac surgery in these patients. Aortic regurgitation may occur due to damage to the aortic valve during VSD closure or dilatation of the aortic root which needs replacement later on [10]. But in our patient severe aortic regurgitation was associated for which aortic valve replacement was done at the same time. Anesthesia for patients with congenital heart disease with valve replacement requires careful preparation of the operation room. Cardiac support drugs should be immediately available and the anaesthesia machine carefully checked preoperatively because of the low margin for error in these patients. The goals for anesthetic management were avoidance of drug induced myocardial depression, maintenance of normovolemia, and prevention of increased ventricular contractility.

Infective endocarditis is a major concern for all patients with congenital heart disease. It is more a concern if associated with mechanical valve replacement. Sterile technique in line insertion and prophylaxis for bacterial endocarditis with antibiotics indicated. This is also true for patients who have undergone palliative or corrective repairs [11,12].

The main concern in patients with mechanical prosthetic valve is the ongoing anticoagulant treatment. Anticoagulant therapy is required in patients with a mechanical prosthetic heart valve to prevent stroke and systemic embolism, and to prevent valve thrombosis, which is associated with a 15% mortality rate [13,14]. Patients with a prosthetic mitral valve, a caged-ball valve, and two prosthetic heart valves are at highest risk for thromboembolic events [15]. Patients with a prosthetic aortic valve and two or more thromboembolic risk factors may be considered at moderate risk for thromboembolic events, whereas patients with a prosthetic aortic valve and less than two thromboembolic risk factors are at lowest risk. The most thrombogenic prosthetic heart valve is the caged-ball type (eg., Starr-Edwards), followed by the tilting disc type (eg., Bjork- Shiley, Lillehei-Kaster), and bileaflet type (eg., St. Jude, Carbomedics), which is the least thrombogenic. Prosthetic mitral valves are more thrombogenic than aortic prostheses because of greater vascular stasis around the mitral valve [15]. In this case, the aortic valve replaced was St. Jude bileaflet metallic valve. CHD patients with shunts are also at risk of shunt thrombosis if anticoagulants are not used appropriately. Clopidogrel, are actively being studied for thromboprophylaxis in children with systemic-pulmonary shunts as additive therapy given the continued occurrence of shunt thrombosis with aspirin [16,17].

The treatment of Patients with a mechanical heart valve or chronic atrial fibrillation who require temporary interruption of warfarin sodium therapy because of surgery or another invasive procedure is a frequently encountered but under investigated clinical problem [18-21]. A major gap in knowledge is a lack of reliable estimates as to the incidence of thromboembolic events associated with warfarin therapy interruption. It is well established, however, that such events can have devastating clinical consequences: thrombosis of a mechanical heart valve is fatal in 15% of patients and embolic stroke results in a major neurologic deficit or death in 70% of patients [14-22,23]. Consequently, despite disagreement on the optimal periprocedural anticoagulation strategy during interruption of warfarin therapy, several authorities and consensus groups advocate, for most patients, some form of bridging therapy with a short-acting anticoagulant [24-30]. The rationale for bridging anticoagulation is to minimize the time before and after a procedure that patients are not receiving therapeutic anticoagulation and, thereby, minimize the risk of thromboembolism. The conventional periprocedural

anticoagulation approach is to hospitalize patients 4 to 5 days before surgery to stop warfarin and administer intravenous unfractionated heparin while the anticoagulant effect of warfarin recedes [31,32]. Intravenous heparin is stopped 3 to 4 hours before the procedure to avoid a residual anticoagulant effect at the time of the procedure. After the procedure, warfarin and intravenous heparin are resumed, the latter administered for 4 to 5 days until therapeutic anticoagulation with warfarin is re-established.

The emergence of low molecular-weight heparins (LMWHs), which can be administered in a fixed, weight-adjusted, subcutaneous dose and without laboratory monitoring, obviates the need for in-hospital perioperative anticoagulation. This approach is appealing because of its convenience, and the potential to substantially reduce health care costs [33,34].

There is an increased risk of intra and post-operative bleeding when surgery is performed in patients who are receiving an anticoagulant [35,36]. In patients who are receiving warfarin therapy with a target INR of 2.0 to 3.0, stopping warfarin 5 days before surgery will, in the vast majority of cases, ensure a normal INR at the time of surgery [37]. In addition to INR testing on the day warfarin therapy is stopped, INR testing should be performed on the day before surgery to ensure that it is normal (INR <1.3) or near-normal (INR=1.4). Patients who undergo surgery with an INR of >1.5 are at increased risk of postoperative bleeding complications [36].

Bridging anticoagulant therapy with LMWH is started, typically, 3 to 4 days before surgery, when a patient's INR is below or is expected to be below the lower limit of the therapeutic range. In patients who are receiving warfarin with a target INR of 2.5 to 3.5, bridging anticoagulant therapy is started when the INR is <2.5, and in patients with a target INR of 2.0 to 3.0, it is started when the INR is <2.0. If twice-daily LMWH is used (e.g., enoxaparin, 1 mg/kg twice daily), the evening dose before surgery should be omitted. With either dosing regimen, the last dose of LMWH should be administered at 20 to 24 hours before surgery, to eliminate the likelihood of a residual anticoagulant effect at the time of surgery [33].

The anticoagulant management in patients who had a spinal puncture before surgery is problematic because of the risk of a spinal epidural hematoma, a rare but devastating complication. In patients who have spinal anesthesia, with epidural catheter removal immediately after surgery, it is safe to resume anticoagulant therapy within 12 hours after surgery. If the epidural catheter placement was traumatic, the resumption of anticoagulants should be delayed for at least 24 hours after surgery. In patients who have an indwelling epidural catheter after surgery to administer analgesia, anticoagulants, in general, should be withheld until the epidural catheter is removed. In our patient, we used single shot non-traumatic caudal epidural for post-operative analgesia.

The decision to resume LMWH after surgery is based on whether there is adequate postoperative hemostasis and the bleeding risk associated with surgery. If there is ongoing bleeding, detected by accumulation of blood into a surgical drain, the resumption of LMWH should be deferred until the bleeding has subsided. Most postoperative bleeding that is due to delayed wound healing will resolve within 24 hours of surgery. In patients undergoing surgery that is associated with a moderate or low risk of bleeding, low-dose LMWH can be resumed on the evening after surgery. If this treatment is well-tolerated, and without bleeding complications, subsequent doses of LMWH can be administered with a full dose regimen, starting 24 to 48 hours after

surgery. In most patients, warfarin can be restarted the evening after surgery. A minimal anticoagulant effect of warfarin will not occur for at least 24 hours after the initial dose of warfarin, and a therapeutic anticoagulant effect will not occur for 4 to 5 days after the start of warfarin therapy [37-39].

To conclude based on an individual assessment of risk factors in patients with congenital heart disease with valve replacement for thromboembolism and the risk of perioperative bleeding; it is possible to form an anticoagulant and antiplatelet management plan likely to achieve a low incidence of bleeding and thrombosis. A multidisciplinary approach is desirable.

References

1. Kouchoukos NT, Blackstone EH, Doty DB (2003) Ventricular septal defect with pulmonary stenosis or atresia. In: Kirklin/Barratt-Boyes cardiac surgery, 3rd Edn. Philadelphia, USA.
2. Murphy JG, Gersh BJ, Mair DD, Fuster V, McGoon MD, et al. (1993) Long-term outcome in patients undergoing surgical repair of tetralogy of Fallot. *N Engl J Med* 329: 593-599.
3. Kirklin JW, Blackstone EH, Jonas RA, Shimazaki Y, Kirklin JK, et al. (1992) Morphological and surgical determinants of outcome events after repair of tetralogy of Fallot and pulmonary stenosis. A two institution study. *J Thorac Cardiovasc Surg* 103: 706-723.
4. Warnes CA, Child JS (2002) Aortic root dilatation after repair of tetralogy of Fallot: pathology from the past? *Circulation* 106: 1310-1311.
5. Warnes CA, Liberthson R, Danielson GK, Dore A, Harris L, et al. (2001) Task force 1: the changing profile of congenital heart disease in adult life. *J Am Coll Cardiol* 37: 1170-1175.
6. Wren C, O'Sullivan JJ (2001) Survival with congenital heart disease and need for follow up in adult life. *Heart* 85: 438-443.
7. Nollert G, Fischlein T, Bouterwek S, Böhmer C, Klinner W, et al. (1997) Long-term survival in patients with repair of tetralogy of Fallot: 36-year follow-up of 490 survivors of the first year after surgical repair. *J Am Coll Cardiol* 30: 1374-1383.
8. Landzberg MJ, Murphy DJ Jr, Davidson WR Jr, Jarcho JA, Krumholz HM, et al. (2001) Task force 4: organization of delivery systems for adults with congenital heart disease. *J Am Coll Cardiol* 37: 1187-1193.
9. Skorton DJ, Garson A Jr, Allen HD, Fox JM, Truesdell SC, et al. (2001) Task force 5: adults with congenital heart disease: access to care. *J Am Coll Cardiol* 37: 1193-1198.
10. Chong WY, Wong WH, Chiu CS, Cheung YF (2006) Aortic root dilation and aortic elastic properties in children after repair of tetralogy of Fallot. *Am J Cardiol* 97: 905-909.
11. Moore RA (1994) Anesthetizing the child with congenital heart disease for noncardiac surgery. In: Barash PG, ASA Refresher course 22: 211-226.
12. American academy of Paediatrics (1991) Prevention of bacterial endocarditis. In: Peter G, Report of the committee on infectious diseases. Elk Grove village, Illinois, USA.
13. Husebye DG, Pluth JR, Piehler JM, Schaff HV, Orszulak TA, et al. (1983) Reoperation on prosthetic heart valves. An analysis of risk factors in 552 patients. *J Thorac Cardiovasc Surg* 86: 543-552.
14. Martinell J, Jiménez A, Rábago G, Artiz V, Fraile J, et al. (1991) Mechanical cardiac valve thrombosis. Is thrombectomy justified? *Circulation* 84: III70-75.
15. Vongpatanasin W, Hillis LD, Lange RA (1996) Prosthetic heart valves. *N Engl J Med* 335: 407-416.
16. Li JS, Yow E, Berezny KY, Bokesch PM, Takahashi M, et al. (2008) Dosing of clopidogrel for platelet inhibition in infants and young children: primary results of the Platelet Inhibition in Children on cLOpidogrel (PICOLO) trial. *Circulation* 117: 553-559.
17. Storm O, Terslev E, Gammelgaard PA (1964) Anticoagulant Prophylaxis At Shunt Operations In Infants And Children with the Tetralogy of Fallot. *Acta Chir Scand* 127: 189-198.

18. Dunn AS, Turpie AG (2003) Perioperative management of patients receiving oral anticoagulants: a systematic review. *Arch Intern Med* 163: 901-908.
19. Spandorfer J (2001) The management of anticoagulation before and after procedures. *Med Clin North Am* 85: 1109-1116.
20. Heit JA (2001) Perioperative management of the chronically anticoagulated patient. *J Thromb Thrombolysis* 12: 81-87.
21. Douketis JD (2002) Perioperative anticoagulation management in patients who are receiving oral anticoagulant therapy: a practical guide for clinicians. *Thromb Res* 108: 3-13.
22. Tiede DJ, Nishimura RA, Gastineau DA, Mullany CJ, Orszulak TA, et al. (1998) Modern management of prosthetic valve anticoagulation. *Mayo Clin Proc* 73: 665-680.
23. Longstreth WT Jr, Bernick C, Fitzpatrick A, Cushman M, Knepper L, et al. (2001) Frequency and predictors of stroke death in 5,888 participants in the Cardiovascular Health Study. *Neurology* 56: 368-375.
24. Kearon C, Hirsh J (1997) Management of anticoagulation before and after elective surgery. *N Engl J Med* 336: 1506-1511.
25. Hewitt RL, Chun KL, Flint LM (1999) Current clinical concepts in perioperative anticoagulation. *Am Surg* 65: 270-273.
26. Madura JA, Rookstool M, Wease G (1994) The management of patients on chronic Coumadin therapy undergoing subsequent surgical procedures. *Am Surg* 60: 542-546.
27. Busuttill WJ, Fabri BM (1995) The management of anticoagulation in patients with prosthetic heart valves undergoing non-cardiac operations. *Postgrad Med J* 71: 390-392.
28. Bryan AJ, Butchart EG (1995) Prosthetic heart valves and anticoagulant management during non-cardiac surgery. *Br J Surg* 82: 577-578.
29. (1998) ACC/AHA guidelines for the management of patients with valvular heart disease. A report of the American College of Cardiology/American Heart Association. Task Force on Practice Guidelines (Committee on Management of Patients with Valvular Heart Disease). *J Am Coll Cardiol* 32: 1486-1588.
30. Ansell J, Hirsh J, Dalen J (2001) Managing oral anticoagulant therapy. *Chest* 119: 22-38.
31. Douketis JD, Crowther MA, Cherian SS, Kearon CB (1999) Physician preferences for perioperative anticoagulation in patients with a mechanical heart valve who are undergoing elective noncardiac surgery. *Chest* 116: 1240-1246.
32. Douketis JD, Crowther MA, Cherian SS (2000) Perioperative anticoagulation in patients with chronic atrial fibrillation undergoing elective surgery: results of a physician survey. *Can J Cardiol* 16: 326-330.
33. Hirsh J, Warkentin TE, Shaughnessy SG, Anand SS, Halperin JL, et al. (2001) Heparin and low-molecular-weight heparin: mechanisms of action, pharmacokinetics, dosing, monitoring, efficacy, and safety. *Chest* 119: 64S-94S.
34. Goldstein JL, Larson LR, Yamashita BD, Fain JM, Schumock GT (2001) Low molecular weight heparin versus unfractionated heparin in the colonoscopy peri-procedure period: a cost modeling study. *Am J Gastroenterol* 96: 2360-2366.
35. Landefeld CS, Cook EF, Flatley M, Weisberg M, Goldman L (1987) Identification and preliminary validation of predictors of major bleeding in hospitalized patients starting anticoagulant therapy. *Am J Med* 82: 703-713.
36. Despotis GJ, Filos KS, Zoys TN, Hogue CW Jr, Spitznagel E, et al. (1996) Factors associated with excessive postoperative blood loss and hemostatic transfusion requirements: a multivariate analysis in cardiac surgical patients. *Anesth Analg* 82:13-21.
37. Palareti G, Legnani C (1996) Warfarin withdrawal. Pharmacokinetic-pharmacodynamic considerations. *Clin Pharmacokinet* 30: 300-313.
38. Horlocker TT (2001) Low molecular weight heparin and neuraxial anesthesia. *Thromb Res* 101: V141-154.
39. Lawton MT, Porter RW, Heiserman JE, Jacobowitz R, Sonntag VK, et al. (1995) Surgical management of spinal epidural hematoma: relationship between surgical timing and neurological outcome. *J Neurosurg* 83: 1-7.