VOLUME - 11, ISSUE - 06, JUNE - 2022 • PRINT ISSN No. 2277 - 8160 • DOI : 10.36106/gjra

Original Research Paper

General Medicine

ELECTRICAL STORM FOLLOWING CORONARY ARTERY BYPASS GRAFTING IN A PATIENT WITH HYPERTHYROIDISM: A CASE REPORT

Jeongyoon Lee	Department of Anesthesiology and Pain Medicine, Daegu Fatima Hospital, 99 Ayang-ro, Daegu 41199, Korea.
Kyeongyoon Woo	Department of Anesthesiology and Pain Medicine, Daegu Fatima Hospital, 99 Ayang-ro, Daegu 41199, Korea.
Haesoo Kim	Department of Anesthesiology and Pain Medicine, Daegu Fatima Hospital, 99 Ayang-ro, Daegu 41199, Korea.
Eunju Kim	Department of Anesthesiology and Pain Medicine, Daegu Fatima Hospital, 99 Ayang-ro, Daegu 41199, Korea.

ABSTRACT An electrical storm, defined as repeated ventricular arrhythmia has been reported as a relatively rare but challenging event. We report a case of an electrical storm following coronary artery bypass grafting (CABG) surgery in a 49-year-old man with untreated hyperthyroidism. The patient underwent successful CABG surgery after being diagnosed with ST elevation myocardial infarction and three vessel disease of coronary artery. Six days after the operation, ventricular tachy-arrhythmias were continuously observed, and direct current cardioversions were performed more than 30 times over 24 hours. Based on laboratory test results, the patient had persistent hyperthyroidism, and we continued anti-thyroid therapy and anti-arrhythmic medication. Eventually, the patient was successfully treated with a second trial of catheter ablation. In conclusion, physicians must carefully manage thyroid function in patients undergoing cardiac surgery. We also recommend that cardiac surgery teams take a multidisciplinary perioperative approach to critical care for cardiac surgery.

KEYWORDS : Arrhythmias, Cardiac; Coronary Artery Bypass; Hyperthyroidism; Catheter Ablation

INTRODUCTION

An electrical storm is defined as a case of repeated ventricular tachycardia/ventricular fibrillation (VT/VF) that commonly requires electrical cardioversion or defibrillation over 24 hours (Kowey, 1996). In addition, very rare cases that occurred after revascularization through stenting or coronary artery bypass grafting surgery (CABG) in patients with acute coronary ischemia have been reported in literature (Ohsawa et al., 2019; Yoshida et al., 2011). Herein we report a case of an electrical storm occurring after emergency CABG surgery in a patient with untreated hyperthyroidism.

CASE HISTORY

A 49-year-old male patient experiencing chest pain for one week was diagnosed with ST- elevation myocardial infarction at a local hospital and transferred to the emergency room. The patient had underlying atrial fibrillation, diabetes, and hyperthyroidism, but had voluntarily discontinued anti-thyroglobulin medication several months prior. An electrocardiogram (ECG) revealed atrial fibrillation and ST-elevation of the anterior chest leads, and cardiac enzyme elevation was observed in laboratory tests. Emergency coronary angiography revealed occlusion of the mid-left anterior descending artery and proximal right coronary artery. Additionally, moderate atherosclerotic coronary artery disease at the left circumflex artery was confirmed; therefore, a diagnosis of three-vessel disease was made. Increased free thyroxine (fT4) (2.65 mg/dL) and decreased thyroid stimulating hormone (TSH) (0.005 uIU/mL) were confirmed by thyroid function tests. The patient's vital signs were stable, and acute cardiac symptoms subsided after administration of nitroglycerine. Considering the patient's condition, CABG was planned three days after admission. To treat the patient's thyroid dysfunction and hyperglycemia before surgery, insulin therapy and anti-thyroid medication (methimazole 10 mg thrice daily) were administered after consulting with an endocrinologist. CABG with cardiopulmonary bypass proceeded three days after admission as scheduled, and no special arrhythmic events occurred during surgery. Continuous amiodarone and esmolol infusions were administered to control atrial fibrillation and tachycardia during surgery.

On the second day after surgery, the patient was extubated with an endotracheal tube, the ventilator was weaned, and the patient recovered until the sixth day after surgery. No specific events occurred; however, atrial fibrillation was continuously observed, and amiodarone, esmolol, and lidocaine were administered to control heart rate. The patient continued to take methimazole to treat thyroid dysfunction. Subsequently, sudden onset VT occurred on the sixth post-operative day. Spontaneous circulation was recovered after five minutes of cardiopulmonary resuscitation and 200 J direct current (DC) cardioversion (Figure. 1).

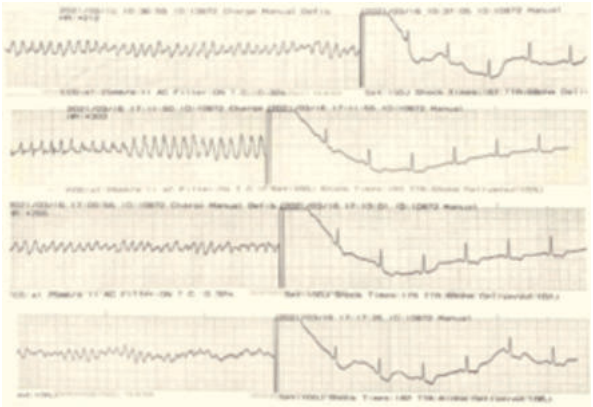

Figure 1: ECG During The Electrical Storm And DC Cardioversion.

No significant interval changes in cardiac function were detected on ultrasound cardiogram compared to pre-operative function. Graft vessel flow was found to be intact on coronary angiogram. VT/VF subsequently occurred over 24 hours, and 150 J DC cardioversion was performed more than 30 times. Indenol, esmolol, lidocaine, and inotropic drugs were administered, and VT/VF continued for over 24 hours. A preceding premature ventricular complex (PVC) was occasionally observed. After consulting with a cardiologist, we successfully performed emergency catheter ablation of PVC-induced foci at the lower apical septum (posteromedial papillary site) and mid upper septal site. Upon checking the

PVC the next morning, VT occurred once again; catheter ablation was therefore repeated. After ablating the mid-anterior septum, no more PVC remained (Figure. 2).

Laboratory tests performed at the time of the electrical storm confirmed a decrease in TSH (0.005 uIU/mL) and an increase in fT4 (2.80 mg/dL), signifying deterioration in thyroid function. Methimazole administration was thereafter continued at the same dose. After two electrophysiology examinations, no arrhythmia was observed, and the patient was transferred to the general ward after implantable cardioverter defibrillator (ICD) insertion. The patient is currently being followed up in an outpatient clinic. According to his ICD records, VF occurred twice in one year.

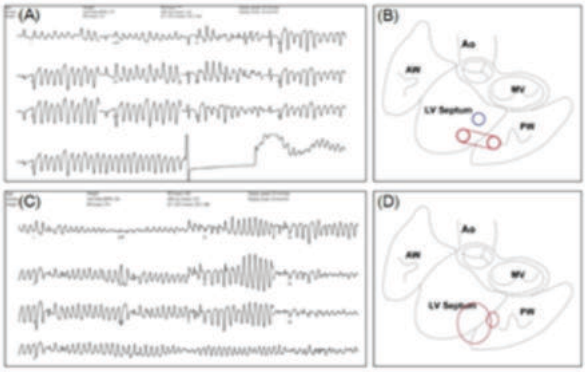

Figure 2: (A) ECG during first catheter ablation; (B) Illustration of the first ablation site on the LV wall; (C) ECG during second catheter ablation; (D) Illustration of the second ablation site on the LV wall.

First catheter ablation of PVC induced VT/VF at lower apical septum (posteromedial papillary site, red circle in figure 2-B) and mid upper septal site (blue circle in figure 2-B)

Second catheter ablation of PVC induced VF at middle anterior septum located between the previous ablation sites, slightly anterior side (red circle in figure 2-D). No PVC was noted after second ablation.

AW; anterior wall, PW; posterior wall, Ao; aorta, MV; mitral valve, LV; left ventricle

DISCUSSION

Electrical storm has been reported as a relatively rare but fatal complication of CABG surgery, with an incidence of 1.0–3.0% and a mortality rate of up to 25% (Nademanee, et al., 2000; Steinberg et al., 1999). Catheter ablation is often required to treat electrical storm, due to its refractory nature (Kowey, 1996; Nademanee, et al., 2000).

There are several hypotheses explaining the pathophysiology of ES (Tan et al, 2012). Abnormal automaticity induced in the His-Purkinje system is associated with the onset of VF, and ischemia in the His-Purkinje system during myocardial infarction may increase susceptibility to arrhythmia. Myocardial fibrosis is known to act as an anchor for re-entry. The re-entrant circuit may exist in the region surrounding the scar formation after myocardial infarction. Due to this pathophysiology, ES can be terminated when catheter ablation is performed using pace-mapping at the lesion site. In addition, Cao et al. (2000) reported that heterogenous cardiac nerve formation and sympathetic hyperinnervation occurs in infarcted myocardium through neural remodeling, which is supported by the treatment of ES through sympathetic block.

Sorajja et al. (2015) reported that hyperthyroidism can be a trigger factor of electrical storm. Furthermore, patients with hyperthyroidism who discontinued treatment before surgery have been reported to experience electrical storm after CABG (Tarçın et al., 2018). In addition, overt hyperthyroidism has been reported to significantly increase the post-operative risk of mortality and morbidity after CABG in patients with coronary artery disease (Lee, 2020).

In the current study, the patient arbitrarily stopped taking anti-thyroid drugs, and overt hyperthyroidism was confirmed preoperatively from thyroid function test results. Additionally, the laboratory tests after the electrical storm indicated that his hyperthyroidism persisted.

To reduce cardiovascular complication from hyperthyroidism, patients should undergo thyroid function tests to ascertain normalcy after taking anti-thyroid drugs for 3–8 weeks before elective surgery. In cases of emergent surgery, thioamides, iodine therapy, steroids, and beta blockers should be considered (Langley et al., 2003). In this case, after consulting with an endocrinologist, the patient received twice the previous dose of methimazole; however, his hyperthyroidism worsened during the arrhythmic event. We therefore recommend aggressive peri-operative anti-thyroidal treatment, such as iodine therapy, in addition to thioamide (methimazole).

In the event of an electrical storm, treatment with amiodarone, beta blockers, and lidocaine can be considered. However, since amiodarone contains iodine, long-term use can exacerbate hyperthyroidism. Cases of electrical storm caused by amiodarone-induced thyrotoxicosis have been previously reported (Sorajja et al., 2015). In this study, our patient received intravenous infusion of amiodarone during surgery for atrial fibrillation. After the electrical storm, lidocaine and esmolol were used to control arrhythmia; amiodarone was discontinued by the cardiologist to prevent the exacerbation of hyperthyroidism. Amiodarone should be administered with caution in patients with hyperthyroidism, and clinicians should consider other anti-arrhythmic medications such as beta blockers and lidocaine when long-term administration is required (Kowey, 1996; Sorajja et al., 2015).

CONCLUSION

Electrical storms are a challenging medical condition for physicians because recurrent arrhythmias can occur despite patients undergoing antiarrhythmic therapy and repeated DC cardioversion. Therefore, the physicians must take a multidisciplinary approach to the intensive care and timely intervention. In addition, this study highlights the need for proper selection of anti-arrhythmic drugs and aggressive treatment of thyroid dysfunction peri-operatively.

REFERENCES

1. Kowey, P.R. (1996), "An overview of antiarrhythmic drug management of electrical storm." The Canadian Journal of Cardiology, 12, 3B-8B.
2. Ohsawa, S., Isono, H., Ojima, E., Toyama, M., Kuroda, Y., Watanabe, S., et al. (2019), "Electrical storm 11 days after acute myocardial infarction: a case report." Journal of Medical Case Reports, 13(1), 1-6.
3. Yoshida, T., Naito, Y., & Nishimura, K. (2011), "Temporary ventricular overdrive pacing for electrical storm after coronary artery bypass grafting." General Thoracic and Cardiovascular Surgery, 59(11), 756-759.
4. Nademanee, K., Taylor, R., Bailey, W.E., Rieders, D.E., & Kosar, E.M. (2000), "Treating electrical storm: sympathetic blockade versus advanced cardiac life support-guided therapy." Circulation, 102(7), 742-747.
5. Steinberg, J.S., Gaur, A., Sciacca, R., & Tan, E. (1999), "New-onset sustained ventricular tachycardia after cardiac surgery." Circulation, 99(7), 903-908.
6. Tan, V.H., Yap, J., Hsu, L.F., & Liew, R. (2012), "Catheter ablation of ventricular fibrillation triggers and electrical storm." Europace, 14(12), 1687-1695.
7. Cao, J.M., Fishbein, M.C., Han, J.B., Lai, W.W., Lai, A.C., Wu, T.J, et al. (2000), "Relationship between regional cardiac hyperinnervation and ventricular arrhythmia." Circulation, 101(16), 1960-1969.
8. Sorajja, D., Munger, T.M., & Shen, W.K. (2015), "Optimal antiarrhythmic drug therapy for electrical storm." Journal of Biomedical Research, 29(1), 20.
9. Tarçın, Ö., Orhan, G., Tandogar, U.N., Mihmanlı, M., Baştopçu, M., & Yekeler, I. (2018), "Does thyroid dysfunction affect early mortality and morbidity after coronary artery bypass graft surgery?" Cardiovasc Surg Int, 5(1), 1-8.
10. Lee, J.H. (2020), "Thyroid storm after coronary artery bypass surgery: a case report." Journal of Cardiothoracic Surgery, 15(1), 1-5.
11. Langley, R.W., & Burch, H.B. (2003), "Perioperative management of the thyrotoxic patient." Endocrinology and Metabolism Clinics, 32(2), 519-534.