ACUTE MYOCARDIAL INFARCTION OCCURRING DURING HEAD AND NECK RECONSTRUCTIVE SURGERY RESCUED BY EMERGENT REVASCULARIZATION - A CASE REPORT

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Abstract

There are numerous factors that will influence coronary plaque progression during perioperative period. Rapid increase in inspired desflurane concentration during anesthetic induction has been shown to transiently increase sympathetic activity and heart rate. However, these adrenergic responses could also occur in a concentration-dependent manner and could induce persistent sinus tachycardia, which is detrimental to patients with coronary artery disease (CAD), if the inspired desflurane concentration is high during operation. Besides, the tendency of desflurane to induce myocardial ischemia in patients with CAD has been revealed in literatures. Here, we present a case suffering from acute myocardial infarction that occurred during head and neck reconstructive surgery under prolonged desflurane anesthesia. After confirming the diagnosis, we halted the operation immediately and sent the patient directly to cardiac catheterization. Finally, he was rescued by emergent revascularization successfully.

Key words: Intraoperative complications, Myocardial infarction, Head and neck surgery, Desflurane, Cardiac Catheterization

Introduction

Perioperative myocardial infarction (PMI) contributes a lot to morbidity and mortality in patients undergoing noncardiac surgery. Preventing the occurrence of PMI is thus a necessity for improving the overall surgical outcome. Therefore, it is extremely important to identify risk factors associated with coronary artery disease (CAD) before operation. Sympathetic hyperactivity such as sinus tachycardia is quite common during desflurane anesthesia and is well tolerated by most patients. However, the overt sympathetic stimulation associated with prolonged desflurane anesthesia might become a burden on the heart that is at risk of CAD. Here, we present a case with cardiac risk factors suffered from acute myocardial infarction (AMI) as the head and neck reconstructive surgery was ongoing under desflurane anesthesia. The etiology and management of PMI will be discussed.

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Case Report

A 62-year-old man, weighing 60 kg, was scheduled for left hemiglossectomy and radical neck dissection due to his lingual squamous cell carcinoma. The operation was combined with reconstructive surgery with anterolateral thigh (ALT) flap for functional and cosmetic purposes. This patient, who had been a heavy smoker and an alcoholic for 40 years, had hypertension under irregular control with thiazide diuretics and diabetes mellitus without treatment. He did not suffer from any discomfort related to cardiovascular and pulmonary system before surgery. His preoperative electrocardiogram (ECG) showed low voltage in all limb leads and possible pathological Q waves over leads III and aVf. However, his transthoracic echocardiogram did not reveal any area of hypokinesis, showing only concentric left ventricular (LV) hypertrophy and mild aortic valvular regurgitation. At the operating room, blood pressure (BP) 184/97 mmHg, heart rate (HR) 68/min, and SpO₂ 98% were obtained by routine monitors before anesthesia. General anesthesia was induced with thiopental 375 mg, fentanyl 100 μg, atropine 0.6 mg, and succinylcholine 80 mg. An oral endotracheal tube, Mallincrot 7.5# cuffed ET tube, was placed without difficulty under direct laryngoscopy. Anesthesia was then maintained with inhalational desflurane in 0.4 L/min O₂, maintaining the end-expired desflurane concentration around 1.5 minimal alveolar concentration (MAC) throughout the procedure plus atracurium. His BP elevated up to 200/100 mmHg, and the HR increased to 145/min immediately after intubation. Later, his BP gradually stepped down into normal range (90-130/55-80 mmHg), but sinus tachycardia (HR 110/min) persisted. Intraoperative monitoring included a three-electrode/one-lead ECG without continuous ST segment analysis, nasopharyngeal temperature, pulse oximetry, capnogram, and direct radial arterial pressure measurement. The first arterial blood gas values draw immediately after placing the arterial catheter were acceptable except the relative high level of hematocrit (49%). His body temperature and end-tidal CO₂ were all within normal range throughout the anesthesia. The lengthy surgical procedure of tumor resection was finally concluded around 9 hours after induction of anesthesia, with mild amount of blood loss (250 mL). The plastic surgeon then began to harvest the ALT flap from the patient’s left thigh. He took additional 2 hours to harvest the free flap for reconstruction with only minimal blood loss (50 mL). The operative and anesthetic course were relative smooth except that sinus tachycardia (100-120 /min), lasted 11 hours throughout the above two surgical procedures despite of intermittent boluses of fentanyl for supplementation of anesthesia and appropriate fluid management (crystalloid 6300 mL, colloid 500 mL, packed red blood cells 500 mL; urine output 850 mL).

While preparing for implantation of the ALT flap, the patient’s BP suddenly dropped to 65/35 mmHg. Although it was rapidly raised to 120/70 mmHg by intravenous ephedrine 12 mg, Q wave widening and ST segment elevation were then noted on the ECG monitor, and his HR further increased up to 125-130/min. Suddenly, short-run ventricular tachycardia appeared for about 10 seconds and spontaneously subsided without treatment. Intravenous lidocaine (60 mg) was given instantly to prevent any recurring ventricular arrhythmia. Owing to these ominous signs, we halted the subsequent reconstructive procedure using the ALT flap just harvested, and arranged a 12-lead ECG examination for him in the regard of an acute coronary event. The result showed marked ST segment elevation and pathological Q waves over all precordial leads (Fig. 1B). We consulted the cardiologist. AMI was highly suspected. We decided to shift the procedure to wound closure with a tongue flap, and the patient was transported to the cardiac catheterization thereafter. Meanwhile, we gave him intravenous infusion of dopamine, nitroglycerin and amiodarone. Emergent coronary angiography revealed 70-90% stenosis with thrombi in situ over distal parts of left anterior descending (LAD) coronary artery (Fig. 2A) and 50% stenosis on
ostium of the first obtuse marginal coronary artery. Anteroapical wall akinesia was also found during left ventriculography. Primary percutaneous transluminal coronary angioplasty (PTCA) with stenting (Liberte 2.75x32 mm, Boston Scientific) for LAD was then successfully performed by the cardiologist, and the narrowed area of LAD disappeared during the subsequent coronary angiogram (Fig. 2B, 2C). Afterward the patient was sent to the intensive care unit (ICU) for further care, where dual antiplatelet therapy with aspirin and clopidogrel was initiated. The values of serum cardiac enzymes peaked on the next day (CK-MB 275 ng/dL, troponin I > 100 ng/dL) and gradually lowered during the subsequent follow-up studies. Although the echocardiogram done on the next day still showed hypokinesis over anteroseptal wall of LV, with impaired LV systolic function, his conditions improved during the ICU stay. He was discharged from the hospital on the 19th day after operation, without receiving any further reconstructive surgery.

Discussions

Patients scheduled to undergo noncardiac surgery should receive a comprehensive risk assessment. Although this patient did not experience any kind of chest discomfort before and his functional capacity was adequate during daily
living activities, stated by himself, there were indeed several cardiac risk factors existed on him, including pathological Q waves on preoperative ECG, history of diabetes mellitus and hypertension. Besides, the head and neck surgery, which this patient just underwent, was also classified as a surgical procedure with intermediate cardiac risk. However, according to the guideline recommended by American College of Cardiology and American Heart Association, the decision to simply proceed directly to operation without receiving any further noninvasive testing didn’t seem unreasonable. Even so, we still arrange a resting echocardiography for him to gain further information about his cardiac status.

Acute disruption of the preexisting plaque in coronary arteries with resultant thrombosis formation is regarded as the most likely etiology of fatal PMI. It is impossible to predict when the vulnerable plaque will become unstable because there are numerous factors that will influence plaque progression during perioperative period. The perioperative period is characterized by overt sympathetic stimulation, and increased prothrombotic and reduced fibrinolytic activity. Increases in adrenergic discharge with accompanying elevation of BP and HR as well as the hypercoagulable condition during this period may promote plaque rupture and coronary thrombosis. In this case, sinus tachycardia which had lasted 11 hours would possibly result in prolonged myocardial oxygen supply/demand mismatch and predisposed to PMI.

While inadequate anesthetic level and hypovolemia were less possible culprits, the uses of atropine for induction and desflurane for maintenance of anesthesia might contribute to prolonged sinus tachycardia in this patient. Because the plasma half-life for atropine is about 2.5 hours, the main contributive role was desflurane. Rapid increase in inspired desflurane concentration during induction has been shown to increase

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Fig. 2. (A) Postoperative coronary angiography before PTCA revealing 70~90% stenosis with thrombi in situ over the distal parts of left anterior descending (LAD) coronary artery (white arrows). (B) Restoration of flow in the LAD coronary artery after successful recanalization with POBA (white arrows). (C) Restoration of flow in the LAD coronary artery after successful recanalization with stenting (Liberte 2.75x32 mm stent) (white arrow). Abbreviations: PTCA - percutaneous transluminal coronary angioplasty; POBA - plain old balloon angioplasty.
sympathetic activity and HR, and the responses are directly proportional to the rate of change in the end-expired concentration of desflurane. Although often short lived in most cases, these adrenergic responses could occur in a concentration-dependent manner. According to the instructions of this agent, concentrations of desflurane exceeding 1 MAC may increase HR. The end-expired concentration of desflurane in this patient was maintained steadily around 1.5 MAC throughout the operation, and might result in the persistent sinus tachycardia.

Besides, the tendency of desflurane to induce myocardial ischemia in patients with CAD has been proved in a previous study. Actually, there were similar cases who suffered from fatal cardiac ischemia during advanced head and neck reconstructive surgery reported in a previous literature. As encountered by this patient, these fatal cardiac events all occurred under prolonged desflurane anesthesia. Although there is no clear evidence to prove the definite relationship between desflurane anesthesia and these fatal cardiac events, further investigation seems necessary to determine the true contribution of desflurane to myocardial ischemia in the patients with CAD undergoing prolonged surgery.

The diagnosis of PMI is more difficult because of the low incidence of chest pain that is often obscured by analgesia and residual anesthetics. Detection of myocardial infarction during general anesthesia would be even more difficult because only changes of serial ECG and biochemical markers could be relied on. The detection rate of ischemia by five-electrode/two-lead ECG with ST-segment trending was very low when compared to the 12-lead ECG. It would be even more difficult to detect the intraoperative event just like what this patient experienced, by only three-electrode/one-lead ECG monitoring without the function of continuous ST segment analysis. Fortunately, we did find out what the patient’s problem was in time before more catastrophes developed. In addition, we got a chance to perform a 12-lead ECG for him while the plastic surgeon was still in preparation for the next step of the operation. The result of this ECG was so diagnostic that we could make the decision to halt the operation immediately and sent him directly to cardiac catheterization.

The adverse cardiac event encountered by this patient belonged to ST-elevation myocardial infarction (STEMI), which was less common in perioperative period than non-ST-elevation myocardial infarction (NSTEMI). The patient with perioperative STEMI most likely benefit from immediate acute reperfusion therapy with primary PTCA, based on its lower risk for postoperative bleeding than with fibrinolytic therapy. Stents are placed in the majority of PTCA procedures, partly because they are very effective in avoiding vessel closure. In our patient, a paclitaxel-eluting Liberte stent was placed in his affected coronary artery (LAD). However, this meant that he should take dual-antiplatelet agents to prevent acute thrombosis at the site of stenting for at least 6 months until re-endothelialization occurred. It would become too dangerous for this patient to resume the unfinished reconstructive surgery only after a short period of treatment course, because the surgery itself did not allow perioperative continuation of dual antiplatelet therapy. If the patient and the surgeon decided to resume the procedure soon after his recovery, a heparin- or phosphorylcholine-coated stent, which may possibly reduce the risk of stent thrombosis in the absence of clopidogrel, would be more suitable for him. Actually, the patient and his family would not like to take the risk of recurrent PMI to undergo surgery again in the near future. So he finally discharged from hospital with unreconstructed and functionally impaired oral cavity and tongue.

The best strategy for managing PMI is to prevent its happening. Preventive strategies include perioperative utilization of β-blockers, α2-agonists, and/or HMG-CoA reductase inhibitors (statin). According to its instructions, desflurane should not be used as the sole agent for anesthetic induction in patients with CAD or patients where increases in HR or BP are undesirable. It should...
be used with other medications, preferably intravenous opioids and hypnotics. Although desflurane was not used for anesthetic induction in this case, this precaution highlights the potential of desflurane to induced myocardial ischemia in patients who are at risk of CAD. It should be more cautious to use desflurane in these groups of patients for prolonged surgical procedure based on the previous observations.16 Once persistent sinus tachycardia has developed during desflurane anesthesia, there are some strategies to alleviate it. Fentanyl partially blunts the hemodynamic effects of desflurane but fails to attenuate the sympathetic response.16 Esmolol and clonidine, which are no longer available in our hospital, also blunt the transient cardiovascular response to a rapid increase in desflurane concentration.17 Moreover, discontinuing and shifting desflurane to other anesthetics should be taken into account while dealing with the problem. In this case, total 300 μg fentanyl had been administered in divided dosage for controlling his HR before the adverse event occurred but in vain. Desflurane had not been lowered or discontinued but maintained at a relative high concentration (1.5 MAC) for 11 hours instead until the event. Of course, there were other possible causes of persistent sinus tachycardia that needed to be differentiated in this case. Diagnosing the problems accurately and correcting them accordingly are more important than just slowing down the HR instead, in the fear of masking any early signs of other serious complications, as what had been considered by us at that time. However, it is also critical for high risk patients to keep the HR less than 85/min by any means,18 including β-blockers, if not contraindicated.

In summary, we present a case of PMI that occurred during head and neck reconstructive surgery under prolonged desflurane anesthesia and was successfully rescued by emergent coronary revascularization with primary PTCA and coronary stenting. This case report emphasizes the importance of coordination and communication among the anesthesiologist, surgeon and cardiologist when an acute coronary event is suspected intraoperatively. Also, the safe uses of desflurane for maintaining lengthy anesthesia in patients who are at risk of CAD need to be reconsidered in our daily clinical practice.

References

頭顱部重建手術中所發生之急性心肌梗塞經緊急心導管處置而成功救治之病例報告

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摘要

手術期間有許許多多的因素會引發冠狀動脈粥狀硬化之恶化，進而造成斑塊破裂，引發急性心肌梗塞。麻醉誘導期中，若desflurane的肺泡濃度上升太快，會暫時地增加交感神經活性造成心搏過速；然而，desflurane增加交感神經活性之程度也與所使用的劑量多寡有關，若術中吸入性麻醉劑的濃度過高的話，很可能會造成持續性的心搏過速，而不利於心血管疾病的患者。此外，文献中也曾提到：使用desflurane於心血管疾病患者身上容易誘發心肌缺氧。在此我們報告了一位使用較高劑量之desflurane來進行長時間的頭顱部重建手術，術中併發急性心肌梗塞之病患：所幸在及時確立診斷之後，我們立即停止手術並緊急將他送至心導管室進行經皮冠狀動脈血管成形術與放置支架而成功救治。

關鍵詞：術中併發症，心肌梗塞，頭顱部手術，心導管手術

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