Surgical Repair for Atrial Septal Defect Associated With Myotonic Dystrophy

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Myotonic dystrophy is a well-known hazard of anesthesia for various kinds of surgery. A 47-year-old male who had an increased CTG repeat of approximately 700 copies in the 3'-untranslated region of the myotonic dystrophy protein kinase gene underwent closure of an atrial septal defect under normothermic beating heart. A strong correlation between reduced left ventricular ejection fraction and stroke volume, and the number of CTG repeats, has been reported. Because this correlation is not completely understood, even if the preoperative cardiac function is normal, it is important to check the number of CTG repeats and the patients who have a large number of them should be carefully treated. (Circ J 2007; 71: 1321–1322)

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Fig 1. DNA analysis by Southern blotting using restriction enzymes EcoR I and BglI. Lane 1, DNA from a healthy control; lane 2, DNA from the patient. The number of CTG repeats in the 3'-untranslated region of the myotonic dystrophy protein kinase gene was estimated as approximately 700.
known as DMPK on chromosome 19. DMPK is localized predominantly at neuromuscular junctions. The number of CTG repeats normally ranges from 5 to approximately 30, but is more than 40 in DM1 patients. The number of CTG repeats and the severity of associated metabolic abnormalities are closely correlated. In DM1 patients, an abnormal expansion of CTG repeats causes changes in the expression of DMPK. Recent investigations have also shown that myotonia in DM1 is caused by a decrease in chloride channel 1 that results from toxic accumulation of abnormally expanded CTG mRNA transcripts in cell nuclei. This in turn causes a defect in splicing of the skeletal muscle chloride channel mRNA and ultimately leads to a marked reduction in the amount of chloride channel protein.\(^2\)\(^3\) Duan et al reported that chloride channels might contribute to: (1) arrhythmogenesis in myocardial injury; (2) cardiac ischemic preconditioning; and (3) adaptive remodeling of the heart during myocardial hypertrophy and heart failure. Therefore we should recognize that antiarrhythmic drugs may have unexpected effects on the heart and muscles of DM patients.

Cardiac involvement, one of the leading causes of death in DM patients, predominantly occurs in the form of cardiac conduction abnormalities. Other less frequent abnormalities are mitral valve prolapse and systolic dysfunction. Tokgozoglu et al\(^4\) examined a large familial cluster of DM and reported that left ventricular ejection fraction and stroke volume as estimated on echocardiography were reduced compared with normal individuals matched for age and heart rate. They also reported a strong correlation between left ventricular wall motion abnormality and the number of CTG repeats.

DM patients also face several problems with regard to anesthesia. On administration of a depolarizing muscle relaxant or neostigmine, hypothermia and shivering or raised serum potassium can cause muscle contraction. As the abnormal muscle membrane itself causes abnormal muscle responses to changes in the extracellular potassium level, blockade of the neuromuscular junction either with nondepolarizing muscle relaxants or with nerve block cannot prevent this abnormal muscular response in DM patients. Mathieu et al reported that the overall frequency of complications was 8.2% and that most complications were pulmonary, including acute ventilatory failure, necessitating ventilatory support because of ateleciasis and pneumonia.\(^8\)

ASD can now be repaired using a special closing device that does not require surgery. After the initial success of nonoperative closure of secundum ASD, the indications of this procedure have been expanded by the improvement in the closing devices. However, the device is not applicable for primum ASD, sinus venosus ASD, and noncentral ASD, which need to be closed surgically.

To obtain myocardial diastolic relaxation and myocardial protection, a cardioplegic solution containing a high concentration of potassium is usually administered during cardiac surgery. The membrane of the dystrophic myotonic muscle is extremely sensitive to changes in extracellular potassium concentration. Normal muscle excitability is usually decreased when there is an elevation of the serum potassium level; however, hyperkalemia in DM patients initially causes muscle hypotonicity, followed by hypertonicity upon further elevation of the serum potassium level. These phenomena occur quite suddenly and unexpectedly. In addition, hyperthermia may also aggravate myotonia. For these reasons, ASD closure in the present case was performed under normothermic conditions with the heart beating without using ordinary cardioplegic solutions. Two reports in the English literature have described MD patients undergoing cardiac surgery. Tanaka et al performed ASD closure under mild hyperthermia without any deleterious effects and did not mention any myocardial protection; and Sakai et al performed ASD closure under normothermic conditions with an empty beating heart; as in the present case.

Although cardiac function can be directly estimated by left ventriculography or echocardiography, the mechanisms and reasons why a higher number of CTG repeats is associated with worsened left ventricular ejection fraction and decreased stroke volume remains unclear. Even if cardiac function appears normal preoperatively, checking the number of CTG repeats is important in DM patients, and those displaying a large number of repeats should be treated carefully. We should also recognize that drugs such as antiarrhythmic agents may have unexpected effects on the heart and muscle of these patients.

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**References**