

SHORT REPORT

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A new surgical scalpel to perform the Waffle procedure for constrictive pericarditis safely

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ABSTRACT

Introduction: Pericardiectomy for constrictive pericarditis is a technical challenge because of dense adhesions to the epicardial surface of the heart. The procedure contains the possibility of unexpected bleeding or cardiac laceration. We present a novel device, to be used during the Waffle procedure, for releasing the constricted visceral pericardium. **Case Report:** A retrospective review of three patients underwent the Waffle procedure using the vessel knife D 500. This knife is a specially designed vessel knife for coronary artery dissection. Intraoperative events, the amount of blood loss, and postoperative cardiac functions were examined. No major intraoperative complications were observed. The average amount of blood loss during the operation was 206 g. Postoperative echocardiography showed improvement in diastolic function in all three patients. **Conclusion:** This device is safe and it is easy to learn how to use it. Moreover, the vessel knife can prevent injury to the myocardium and coronary artery underlying the thickened visceral pericardium.

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INTRODUCTION

Constrictive pericarditis is a type of subacute inflammations. Not only thickened parietal pericardium but also the fibrotic thickening visceral pericardium contributes to the pathogenesis of constriction. Surgical treatment is almost always required to remove the thickened and constricted visceral pericardium associated with removal of thickened parietal pericardium [1, 2]. Removal of the thickened visceral pericardium is a very difficult procedure because intense myocardial bleeding or injury to coronary arteries may occur. During the past several decades, many new techniques have been developed. One of the new techniques is to make transverse and longitudinal incisions in the visceral pericardium, cutting it into smaller fragments which allow the heart to successfully dilate and fill adequately, resulting in hemodynamic improvement. This method was originally presented by Heimbecker in 1983 [3]. This procedure was then called 'The Waffle Procedure'. However, this procedure still presents potential risks of unexpected bleeding caused by myocardial or coronary arteries injury, this is because the thickened

visceral pericardium does not allow identification of the underlying correct anatomy of the coronary arteries and myocardium. Traditionally, typical surgical scalpels have been used for the Waffle procedure; however these scalpels are too large to ensure a fine control of the point of blade on the thickened and hardened visceral pericardium. Therefore, we employ a new surgical scalpel, the vessel knife D 500 (Mani, Utsunomiya, Tochigi, Japan), during the Waffle procedure (Figure 1).

CASE REPORT

The cardiac exposure is obtained through a median sternotomy in the usual manner. The constrictive pericarditis is also relieved in the usual manner including pericardiectomy with careful attention to the phrenic nerve preservation under cardiopulmonary bypass. When the heart is covered with thickened visceral pericardium consisting of dense fibrotic tissue, a series of visceral pericardial incisions, “the Waffle Procedure” begins in both the longitudinal and transverse directions using the vessel knife D 500. The entire surfaces of both ventricles and right atrium are incised in a similar manner until the visceral pericardium has been converted into small sections of scar tissue (Figure 2). The atrial and ventricular chambers begin to expand immediately with increasing ventricular contractility as the sections of visceral pericardium separate.

RESULTS

We have used this vessel knife in three patients with constrictive pericarditis (Table 1). No major intraoperative complications were observed, such as unexpected bleeding caused by myocardial or coronary arteries injury. The average amount of blood loss during the operation was 206 g. Although, preoperative NYHA functional class was III in all three patients, postoperative NYHA functional class improved to I in all patients. Postoperative echocardiography improved in diastolic function, including mitral annulus velocity (E') in all three patients [4] (Table 2). The ratio of lateral E' to septal E' (E'lat/ E'sep) were normalized to 1 or more. The patients are doing well after the operation without any sign of recurrence.

Table 1: The intraoperative outcomes of three patients.

Case	Unexpected Bleeding	Cardiac laceration	Coronary artery damage	Amount of bleeding (g)
1	(-)	(-)	(-)	230
2	(-)	(-)	(-)	186
3	(-)	(-)	(-)	201

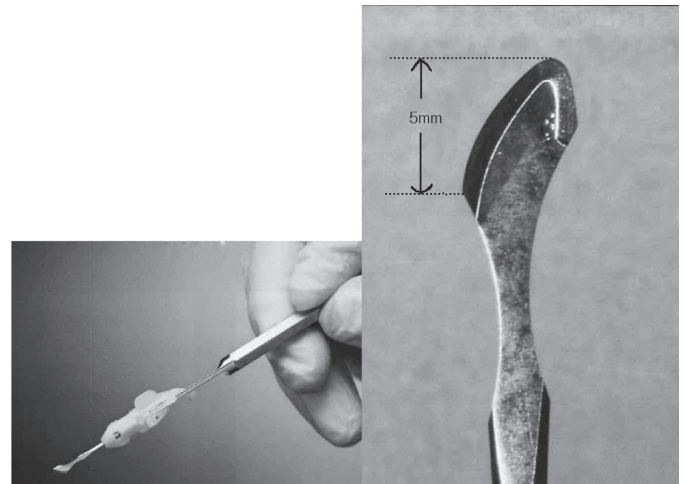


Figure 1: The image of the vessel knife D 500 in full-size and magnified figure.

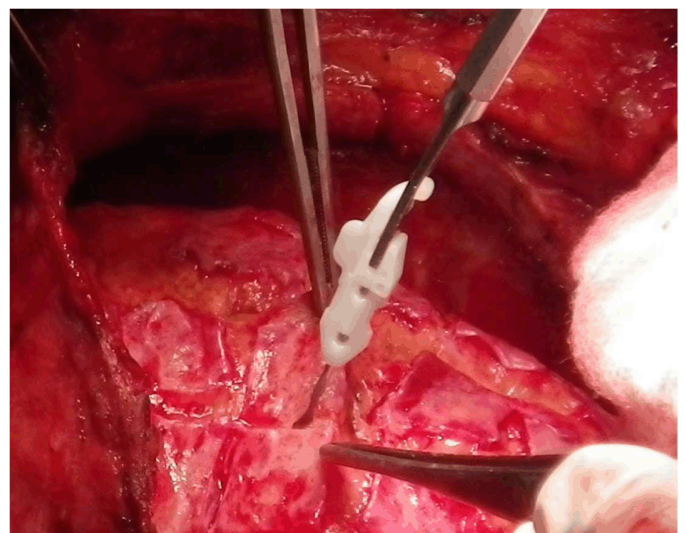


Figure 2: Intraoperative image showing multiple incisions have been made on the thickened visceral pericardium.

DISCUSSION

The vessel knife D 500 is specially designed for use in coronary artery dissection, hence why this knife has a small and very sharp blade which allows fine control at the point of the blade. Furthermore, the shape of the blade allows it contact to the surface of the thickened visceral pericardium in a parallel method. Therefore, the blade can cut the thickened pericardium at constant depth. This knife can be used more safely and comfortably than other devices to perform the Waffle procedure, despite of which there is no published report on its clinical use. We have used this device for three patients and their postoperative cardiac functions were improved. Moreover, we have not yet encountered any bleeding or coronary artery damage. We consider that the use of the vessel knife D 500 for the Waffle procedure is a very effective and safe method.

Table 2: The change in echocardiographic findings of three patients preoperative and postoperatively

Case	Pre / Post NYHA	Pre / Post RVP	Pre / Post E` (lat) / E` (sep)	Pre / Post IVC diameter (expiration)	Pre / Post IVC respiratory Variation
1	III / I	32 / 22	0.53 / 1.24	27 / 24	N / Y
2	III / I	29 / 23	0.95 / 1.39	25 / 22	N / Y
3	III / I	34 / 25	0.76 / 1.19	29 / 21	N / Y

Pre: preoperative; Post: postoperative; NYHA: New York Heart Association functional classification; RVP: right ventricular pressure E` (lat) / E` (sep): ratio of E` (lat) / E` (sep); E` (lat): lateral mitral annular velocity; E` (sep): septal mitral annular velocity; IVC: inferior vena cava; N: no; Y: yes

CONCLUSION

The use of the vessel knife D 500 for the Waffle procedure is a very effective and safe method. It has caused no myocardial or coronary injury therefore there has been no unexpected bleeding.

Author Contributions

Koji Tsutsumi – Substantial contributions to conception and design, Acquisition of data, Analysis and interpretation of data, Drafting the article, Revising it critically for important intellectual content, Final approval of the version to be published

Yoshihiko Mochizuki – Substantial contributions to conception and design, Acquisition of data Analysis and interpretation of data, Drafting the article, Critical revision of the article, Final approval of the version to be published

Masahiko Okamoto – Substantial contributions to conception and design, Acquisition of data Analysis and interpretation of data, Drafting the article, Critical revision of the article, Final approval of the version to be published

Ichiro Kashima – Substantial contributions to conception and design, Acquisition of data Analysis and interpretation of data, Drafting the article, Critical revision of the article, Final approval of the version to be published

Takahito Itoh – Substantial contributions to conception and design, Acquisition of data Analysis and interpretation of data, Drafting the article, Critical revision of the article, Final approval of the version to be published

Guarantor

The corresponding author is the guarantor of submission.

Conflict of Interest

Authors declare no conflict of interest.

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