Percutaneous Balloon Compression Technique using Intraoperative DynaCT for the Treatment of Trigeminal Neuralgia: Technical Note

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BACKGROUND

Percutaneous balloon compression (BC) is a well-established technique that can provide immediate therapeutic relief to patients suffering from trigeminal neuralgia (TN). The general procedure of BC uses fluoroscopy imaging to guide the needle through the foramen ovale (FO). The aim of this study was to describe our experience with a novel technique using intraoperative DynaCT as an adjunct for more accurate guidance of the needle to the FO.

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INTRODUCTION

Percutaneous balloon compression (BC) is a well-established technique that can provide immediate therapeutic relief to patients suffering from trigeminal neuralgia (TN). BC is an effective method that works by targeted injury of the trigeminal nerve fibers, but TN can be challenging and technically difficult to manage due to the vital structures adjacent to the origin of the Gasserion ganglion. The general procedure of BC uses fluoroscopy imaging to guide the needle through the foramen ovale (FO). However, direct cannulation of the FO can be difficult and can lead to complications, including the possibility of injury to the internal carotid artery. DynaCT imaging has been used to facilitate guide-wire navigation through difficult structures. Specifically, by providing three-dimensional images, this has been shown to be a tool that allows for easier positioning and insertion of the needle through the FO. The aim of this study was to examine a new technique using intraoperative DynaCT as an adjunct for more accurate guidance of the needle to the FO.

METHODS

In this study, DynaCT was used to perform BC in 14 TN cases. The three-dimensional path of the needle was pre-planned using DynaCT and the FO was accessed with needle-guided bi-plane fluoroscopy. DynaCT was used for confirmation of the final position of the needle prior to insertion of the balloon as well as for confirmation of the position of the balloon after inflation.

RESULTS

DynaCT-guided percutaneous BC allowed for precise needle placement and positioning. It facilitated easier cannulation of the FO by providing three-dimensional images for needle guidance. In all 14 patients, the pain improved immediately and the patients achieved numbness in the trigeminal branches. All patients had a quick postoperative recovery. There were no complications.

DISCUSSION

Percutaneous BC is an effective method that works by targeted injury of the trigeminal nerve fibers. In percutaneous BC, needle placement through the FO allows access to Meckel's cave as well as to the different components of the trigeminal nerve that can be involved in the transmission of pain in TN. However, direct cannulation of the FO can be difficult and lead to complications due to adjacent vital structures.

DynaCT, in comparison to fluoroscopy, allowed for quicker, safer, and more precise targeting of the needle to different parts of the FO, while avoiding nearby structures. It provided three-dimensional images, allowing optimal and reliable needle positioning to the cannulate the FO, balloon positioning, and balloon inflation due to improved visualization. In our cohort of patients, the use of DynaCT provided excellent clinical results, and all patients had a quick postoperative recovery. Administration of contrast material intravenously before 3D reconstruction during the arterial phase allowed the surgeon to avoid not only the carotid artery, but also smaller vessels like the facial artery, injury of which could potentially cause a soft tissue hematoma.

DynaCT-guided BC is indicated in patients suffering from TN. Indications include patients who have multiple sclerosis, patients who have undergone prior BC, patients who have had a failure of surgery, elderly and other high risk patients as well as those who have not responded to gamma knife therapy. Additionally, patients suffering from bilateral TN are also acceptable candidates for DynaCT-guided BC.

CONCLUSIONS

The advantages of the DynaCT-guided technique include a single precise needle pass, less trauma, and avoidance of vessel injury. Precise placement of the balloon into different aspects of the FO can target trigeminal branches more selectively and allow for a better outcome.

FIGURES

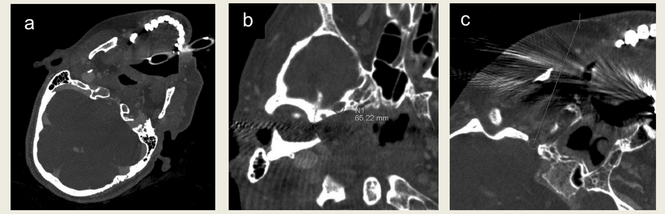

Figure 1. a) A representative DynaCT image obtained with IV contrast clearly shows the right facial artery and vein, the right carotid artery, the right jugular vein and the relevant osseous structures. b) The target right foramen ovale is identified, just medial to the right foramen spinosum. c) The path from the skin to the right foramen ovale is plotted, avoiding the right facial artery.

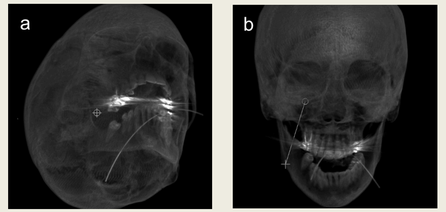

Figure 2. Three dimensional down-the-barrel (a) and AP (b) views, demonstrating the plotted needle path from the skin to the right foramen ovale.

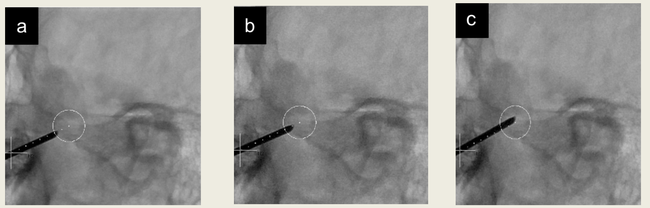

Figure 3. a - c) Lateral views demonstrate step-by-step advancement of the Toughy needle into the left foramen ovale along the plotted needle path.

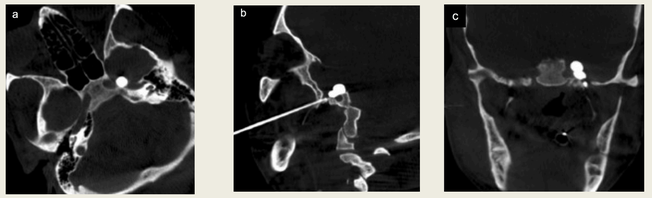

Figure 4. a – c) Intraoperative DynaCT performed for evaluation of the inflated balloon in axial (a), sagittal (b) and coronal (c) views.