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Review

Lead extraction using a laser system: Techniques, efficacy, and limitations

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ABSTRACT

Transvenous lead extraction is becoming popular in Japan since the approval of laser extraction system in 2010. The laser system seems to be the standard method used by most physicians, owing to its efficacy and ease of handling. The efficacy and safety of this technology has been well proven in many studies and the data suggest that it can be used for Japanese patients safely. However, lead extraction can cause serious complications. Thus, it is important to learn the limitations as well as the basic techniques and efficacy of this procedure.

Contents

1. Introduction

Laser-assisted lead extraction was approved in Japan in 2010. The system itself has been in use in western countries for many years and its effectiveness as well as safety has been proven in many studies. Various methods are used for a transvenous lead extraction. However, the laser-assisted system seems to be the standard method used by most physicians, owing to its efficacy and ease of handling. Needless to say, any lead extraction method has limitations and a risk of major adverse events (MAEs). It is important, not only for the physicians but also for the medical staff involved in this procedure, to understand the benefits and limitations of this system.

2. History

An excimer laser system for the extraction of permanent pacemaker lead has been developed by Spectranetics Inc. (Colorado Springs, CO) and the first extraction was performed by Dr. Charles L. Byrd in 1994. In 1998 [1], Dr. Kennergren reported their experiences to use an excimer laser. The initial model of laser sheath (SLS I) was modified and a second-generation laser sheath (SLS II) was launched in the market in 2002. The major improvements included a more flexible distal of the laser sheath up to

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10 cm and a slight bevel of the tip, as much as 15° (Fig. 1). The efficacy and safety of this laser sheath has been proven in many articles throughout the literature. SLS II was approved in Japan in 2010.

3. How it works

The laser sheath fiber-optically delivers the laser energy to the distal end of the sheath, releasing the lead from the encapsulating fibrotic tissue. The sheath is constructed using 82 optical fibers, each with a core diameter of 100 μm, around an inner lumen. The CVX 300 (Fig. 2, Spectranetics, Colorado Springs, CO) emits an excimer laser beam utilizing xenon chloride, with an output of 308 nm, which falls in the ultraviolet region, not visible for humans. This cool cutting laser has an absorption depth of 0.05 mm, the energy being absorbed by proteins and lipids. These parameters are well suited for lead extraction, allowing cutting of the tissue without damaging the veins or insulation of lead.

4. How to use

The SLS II laser sheath comes in three different sizes; 12 French (F), 14 F, or 16 F (Fig. 2), according to the diameter of extracting lead. Each sheath permits removal of lead with a maximum outer diameter of 7.5 F, 9.5 F, and 11.5 F, correspondingly. The SLS II laser sheath was positioned over the targeted lead and adhesions were lysed using the laser when required (Fig. 3). The beveled edge of the sheath was kept on the inside when approaching the brachiocephalic curve. The lead tip was freed by performing "counter traction", applying adequate traction to the lead while retaining

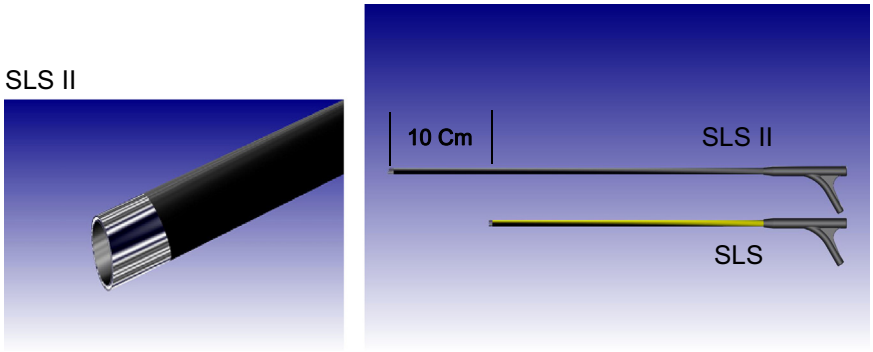

Fig. 1. SLS II, the second-generation laser sheath. The tip of the sheath has a slight bevel of about 15° (left panel). The distal part, up to 10 cm, is more flexible than the original laser sheath (right panel).

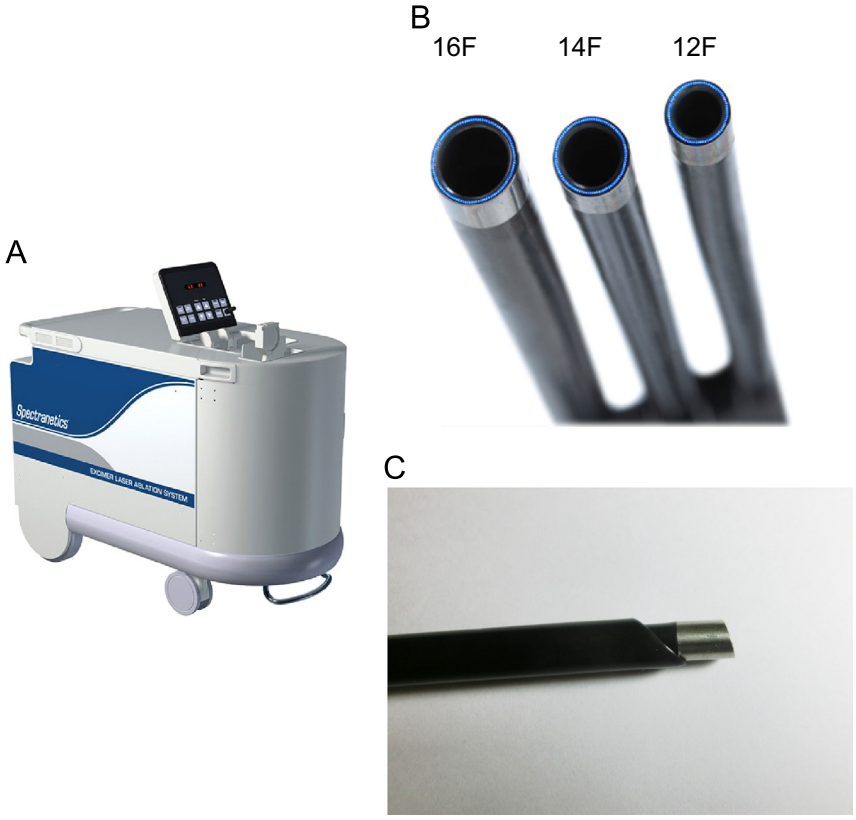

Fig. 2. (A) CVX 300 (Spectranetics, Colorado Springs, CO), the generator that emits an excimer laser utilizing xenon chloride with an output of 308 nm. (B) SLS II laser sheath with a line up of three sizes. The sheath is constructed using 82 optical fibers, each with a core diameter of 100 μm, around an inner lumen. (C) Mechanical outer sheath over the inner laser sheath.