Radiologically-Guided Percutaneous Cryoablation in Vascular Malformations

Vascular malformations (VMs) can cause patients substantial cosmetic and functional issues, as well as psychological distress. Standard techniques used to treat them include nidus embolisation, followed by surgical excision with plastic surgery follow-up [1-5]. A portion of these malformations are refractory to standard treatment. Novel techniques under investigation include magnetic-resonance-guided high intensity focused ultrasound ablation (MR-HIFU) [6,7], percutaneous cryoablation [1-3,5,8-10], radiofrequency ablation (RFA) and laser ablation [4]. I have described percutaneous cryoablation, as it is a minimally invasive technique which has shown superb local control in VMs that are refractory to standard treatment.

Cryoablation is a technique performed under general or local anaesthesia, with ultrasound guidance. Percutaneous cryoprobes are introduced into the target VMs along their long axis. The distance between the probe and critical structures such as the skin or nerves has to be more than 5mm for successful hydro-dissection. Non-enhanced CT is usually performed to assess the position of the cryoprobe before ablation [10]. Cryoprobe activation causes an ice-ball to form. It is imperative to prevent ice extension to the skin, and this is monitored visually. A warm bag of saline can be placed on the skin as protection against freezing. The probe is allowed to thaw before being withdrawn. This freeze-thaw cycle can be repeated for large lesions. Radiologically, ultrasound and MR (T1- and T2-weighted) assessment can be performed before and after treatment [1-3,5,8]. Clinically, assessment includes the patient's perception of pain, associated symptoms and treatment complications.

There have been several case and cohort studies of cryoablation of VMs previously refractory to sclerotherapy. They showed clinical and radiological response in the majority/all of the patients [1,2,5,8,10]. Approximately 50 patients were investigated. Patients reported significant reduction in pain, pain frequency, size of mass, hyperesthesia and functional restrictions [5,10]. In one study, all patients became pain-free [2,3]. It was found that poor candidates for cryoablation tend to have diffuse involvement of the malformation, pain and associated symptoms that are discordant to the VM's location [3]. The mechanism of minimising vascular malformation re-growth in cryoablation may be the downregulation of vascular endothelial growth factor [3,10].

The benefits of cryoablation include effective treatment of VMs, real-time imaging, lower complication rates, and reduced likelihood of damage to local critical structures. Real-time visualisation of the ablation zone allows cryoablation to cause less damage than conventional surgery [1-3,5]. Complication rates are reduced due to easy planning and monitoring via ultrasound, CT and MRI. Major complications include nerve injury and severe dysesthesia [10]. Minor complications include pain/discomfort, skin breakdown and numbness [1,2,8,10]. This technique, similar to RFA and laser ablation, requires percutaneous insertion of a probe into the target lesion, unlike the completely non-invasive MR-HIFU [6,7].

It is exciting that cryoablation is becoming part of the expanding repertoire of minimally invasive techniques in managing complex vascular anomalies that have been refractory to conventional intervention. Real-time imaging and hydro-dissection allow adjacent critical structures to be protected. Significant pain reduction with a concomitant increase in function has been reported.

References:

1. F.H. Cornelius, A. Neville, et. al, Percutaneous Cryotherapy of Vascular Malformation: Initial Experience, Cardiovascular and Interventional Radiology, 2013, 36, p853-856.
2. F.H. Cornelis, M. Havez, et. al, Percutaneous Cryoablation of Symptomatic Localized Venous Malformations: Preliminary Short-Term Results, Journal of Vascular Interventional Radiology, 2013, 24, p823-827.
3. R. Shaikh, Percutaneous Image-Guided Cryoblation in Vascular Anomalies, Seminars in Interventional Radiology, 2017, Vol. 34, No. 3, p280-287.
4. P. Patel, A.M. Barnacle, et. al, Endovenous laser ablation therapy in children: applications and outcomes, Pediatric Radiology, DOI 10.1007/s00247-017-3863-4.
5. R. Shaikh, A. I. Alomari, et. al., Cryoablation in Fibro-Adipose Vascular Anomaly (FAVA): a minimally invasive treatment option, Pediatric Radiology, 2016, 46, p1179-1186.
6. J. M.M. van Breugel, R.J. Nijenhuis, et. al, Non-invasive Magnetic Resonance-guided High Intensity Focused Ultrasound Ablation of a Vascular Malformation in the Lower Extremity: a Case Report, Journal of Therapeutic Ultrasound, 2015, 3, p23.
7. P. Ghanouni, S. Kishore, et. al, Treatment of Low-Flow Vascular Malformations of the Extremities Using MR-guided High Intensity Focused Ultrasound: Preliminary Experience, Journal of Vascular and Interventional Radiology, 2017, Dec 1:28, 17, p1739-1744.

8. S. Woolen and J.J. Gemmete, Treatment of Residual Facial Arteriovenous Malformations after Embolisation with Percutaneous Cryotherapy, Journal of Vascular Interventional Radiology, 2016, 27, p1570-1575.
9. F.H Cornelius, C. Labreze, et. al, Percutaneous Cryoablation as Second-Line Therapy of Soft-Tissue Venous Vascular Malformations of Extremities: A Prospective Study of Safety and 6-Month Efficacy, Cardiovascular and Interventional Radiology, 40, p1358-1366.
10. F.H. Cornelius, F. Marin, et. al, Percutaneous cryoablation of symptomatic venous malformations as a second-line therapeutic option: a five-year single institution experience, European Radiology, 2017, 27, p5015-5023.