3D Visualisation of normal and diseased nerves – first experience

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Objective

2D Nerve ultrasound (NUS) is established as diagnostic tool in peripheral nerve disorders (PND) like compression syndromes, nerve trauma and nerve tumors. In disorders like inflammatory neuropathy its value concerning diagnosis and monitoring of disease is currently evaluated. However, there was the idea that NUS could offer further advantages like understanding of pathophysiology or progression in hereditary and chronic PND.1,2 It allows real-time in-vivo imaging, is non-invasive, pain free and works without radiation. Therefore it is ideal for use in longitudinal studies. Currently, the cross sectional area is the most widespread parameter that is used for distinguishing healthy from diseased nerves. For going further, like monitoring of circumscribed lesions and their evolution over time, use of the third dimension and therefore monitoring volumes might be useful. We therefore aimed at gathering first experience in rendering 3D models of nerves.

Methods

Clinically affected nerves of one patient with carpal tunnel syndrome (CTS), one with ulnar neuropathy at the elbow (UNE), one with inflammatory neuropathy and three healthy volunteers were scanned for abnormalities with a Logiq E9 platform and a ML6-15 MHz probe, that was connected to a 3D tracker of Piur Imaging (Vienna). Volume data were stored as clips containing between 180-300 separate slices and manual segmentation performed offline afterwards according to available recommendations with measuring just inside the hyperechogenic epineural or perineural rim. Within a final step the segmented rim was rendered to get 3D-views of the nerve.

Figure 2: Manual segmentation of a single fascicle of and the median nerve as a whole (upper row) and subsequent rendered 3D-model (lower row)

Conclusion

3D ultrasound allows visualisation of whole nerve segments including single diseased fascicles when enlarged with a 15 MHz probe. Using probes with higher frequency might offer additional benefit of fascicle identification. Therefore, it seems plausible that 3D ultrasound can be used for gaining new insights in monitoring progression and knowledge about longitudinal pathophysiologic changes in chronic PND.

References