Abstract CODE : A062

TYPE : ORAL PRESENTATION

CATEGORY : VASCULAR INTERVENTION

TITLE

Properties of the mixture of n-Butyl-2-cyanoacrylate (NBCA) and ethiodized oil according to the mixing method

BACKGROUND

Effective embolic agents are crucial for achieving successful outcomes in embolization procedures. Initially approved by the FDA for the treatment of cerebral vascular malformations, n-Butyl-2-cyanoacrylate (NBCA) has been widely employed as an embolic agent for a wide range of vascular and lymphatic pathology, arterial pseudoaneurysms, endoleaks, and vascular tumors. NBCA has low viscosity and rapid polymerization speed allowing easy injection through microcatheters and fast embolization of the targeted vessel. However, NBCA is radiolucent and cannot be visualized during the procedure and fast polymerization time can cause adhesion of the catheter tip to the vessel presenting significant challenges in its usage. The addition of ethiodized oil to NBCA increases viscosity allowing better control, delays polymerization, increases diffusion capacity and enables visualization during procedures. The mixture of NBCA and ethiodized oil achieves embolization effects comparable or superior to other embolic agents. There is a substantial body of research demonstrating the properties of mixtures and the utility of embolization using different ratios of NBCA and ethiodized oil. However, there is currently no research on the effects of mixing methods on the properties of the mixture. In clinical practice, there are cases where the mixture of n-Butyl-2-cyanoacrylate and ethiodized oil does not exhibit consistent embolization effects despite using the same ratio. The characteristics of the NBCA and ethiodized oil mixture can be influenced by how it is mixed, ultimately resulting in variations to the overall physical property such as viscosity and polymerization time. Therefore, this study aimed to investigate the impact of two different mixing methods (hand stirring in a medicine cup vs syringe pumping using a 3-way stopcock) on the properties of the mixture of n-Butyl-2-cyanoacrylate and ethiodized oil. We analyzed the viscosity, polymerization time, and gross morphology of the embolic mixture which can ultimately improve the quality and efficacy of embolic agents, leading to enhanced patient outcomes in interventional radiology practice.

METHODS

N-Butyl-2-cyanoacrylate and ethiodized oil was mixed in two different methods. First, hand stirring with a medicine cup. Second, syringe pumping using a 3-way stopcock. Flow time, polymerization time, and particle shapes after polymerization were analyzed.

RESULT

The syringe pumping using a 3-way stopcock method, compared to hand stirring with medicine cup method, showed faster flow time (mean time 19.9 ± 1.33 seconds versus 28.1 ± 5.77 seconds, $p < 0.0005$) and polymerization time (mean time 102.4 ± 4.9 seconds versus 123.3 ± 28.9 seconds, $p < 0.0005$) of the n-Butyl-2-cyanoacrylate and ethiodized oil mixture. The 3-way stopcock method resulted in a more homogenous polymerization of particles.

CONCLUSIONS

The syringe pumping method showed faster flow time, faster polymerization and a more homogenous particle shape compared to the hand stirring method. Utilization of the syringe pumping method may enable a more stable and effective injection.

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