Invisible nanocoatings for therapeutic nitric oxide delivery via phenol-amine networks

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Interventional devices such as guide catheters, ventricular assist devices, and glaucoma drainage implants, are regularly used to improve patient outcomes and quality of life. While effective, these devices can sometimes pose a risk to patients by causing infections and/or inflammations.[1] To avoid these issues, antibiotics can be prescribed as a prophylactic measure. However, the use of antibiotics is also associated with serious side effects as well as further compounding the increase in antibiotic resistance. As such alternative strategies are being considered, such as nitric oxide (NO). NO is a signaling molecule involved in various pathological and physiological processes.[2] Importantly, NO has a short half-life, which therefore requires NO to be delivered at target sites to increase therapeutic benefit.[3] This project aims to develop a phenol-amine nanocoating on polyvinyl chloride (PVC) medical tubing to release NO, specifically by promoting the catalytic release of the endogenous NO donor *S*-nitrosoglutathione (GSNO). A 'one-pot' synthesis method was established to apply a NO-releasing coating on medical-grade PVC tubes using tannic acid (TA) and selenocystamine (SeCA), which promotes local NO production through glutathione-like peroxidase (GPx) activity by degrading GSNO (Figure 1a). Despite the coating's transparency, it was confirmed by characterizing various TA: SeCA molar ratios (ranging from 1:0.1 to 1:2) through water contact angle measurements (Figure 1b), X-ray photoelectron spectroscopy (XPS), and electron microscopy. Additionally, the gallic acid and amine components of the coatings endowed the materials with good stability and a tunable range of NO production rates, as evidenced by significant peaks in NO flux concentration in tubes with higher TA: SeCA ratios (Figure 1c). These findings suggest that phenol-amine-coated materials may represent a viable strategy to mitigate medical device-associated infections.

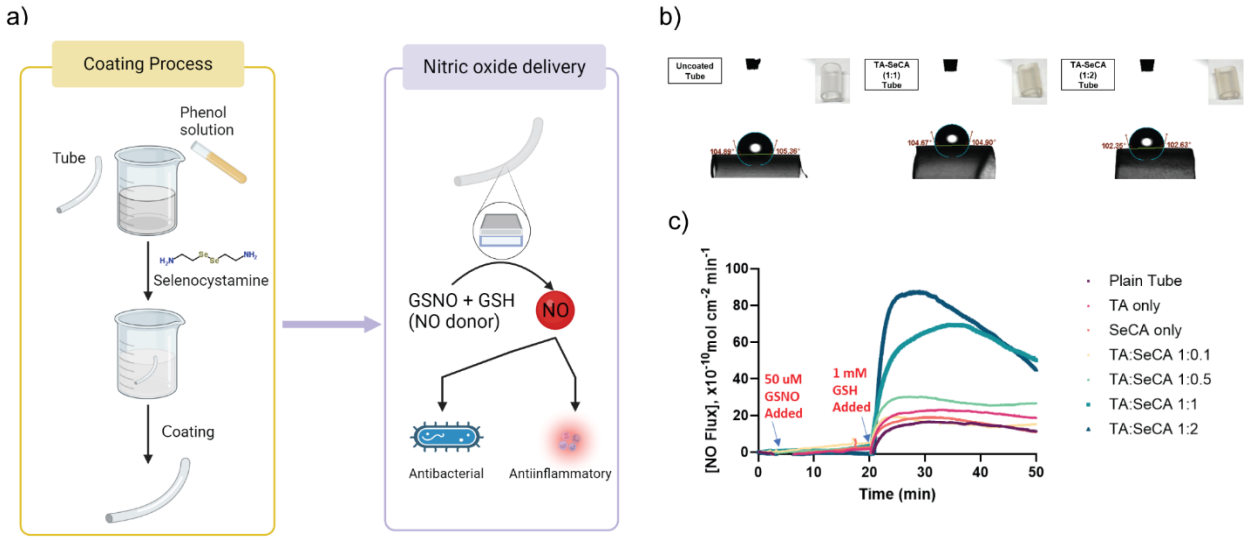

Figure 1: a) Schematic of phenol-amine nanocoatings for therapeutic NO generation. b) Water contact angle for uncoated tube, TA-SeCA (1:1) and TA-SeCA (1:2). c) Catalytic NO generation patterns.

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