

ORIGINAL RESEARCH—SINONASAL DISORDERS

# Fluid residuals and drug exposure in nasal irrigation

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*Sponsorships or competing interests that may be relevant to content are disclosed at the end of this article.*

## ABSTRACT

**OBJECTIVE:** Topical treatment options in chronic rhinosinusitis (CRS) are growing with our increased understanding of the inflammatory process. Additives to irrigation devices have become popular. Additives such as menthol provide little more than sensory feedback. However, glucocorticosteroids and antibiotics represent powerful pharmaceutical agents for which we have little knowledge regarding patient exposure and absorption. There is little data on fluid retained after nasal irrigation. The purpose of this study was to determine the residual volume and percentage of total nasal irrigation that is retained from a neti pot (NasaFlo) or squeeze bottle (Sinus Rinse).

**STUDY DESIGN:** Cross-sectional study.

**SETTING:** Tertiary rhinologic clinic.

**METHODS:** Patients with CRS were already using saline irrigation in their treatment. Participants were divided into pre and post sinus surgery (ESS). Control irrigations on 17 healthy patients with no sinonasal complaints were collected. Nasal irrigation was performed with accurate collection of the excess to determine retained amount.

**RESULTS:** Overall retention of fluid was  $2.5 \pm 1.6$  percent. This represents only  $5.8 \pm 3.8$  mL for the 240-mL irrigations. Squeeze bottle and neti pot were similar:  $2.3 \pm 1.3$  percent and  $3.0 \pm 2.2$  percent, respectively ( $P = 0.23$ ). CRS (pre-ESS) patients had the least retained volume:  $1.4 \pm 1.2$  percent. Post-ESS retained volume was  $2.36 \pm 1.18$  percent. Control patients retained  $2.2 \pm 1.2$  percent.

**CONCLUSIONS:** Quantification of the residual volume has important implications for the treatment of inflammatory disease with saline, as well as for potentially novel topical therapies. The information helps to define the fluid dynamics during nasal irrigation. The data are important to address concerns regarding drug or salt exposure from a very common intervention.

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Nasal irrigation with saline or other novel topical solutions is commonly advocated by physicians treating chronic inflammatory disease of the paranasal sinuses.<sup>1</sup> Recent advances in the understanding of the pathophysiology

of chronic rhinosinusitis (CRS) have led to new medical treatments. Many of these treatments will be delivered locally via nasal irrigation. Therapeutic additives such as surfactants,<sup>2</sup> steroids,<sup>3</sup> and antibiotics<sup>4</sup> may be delivered topically in concentrations higher than by systemic routes. The ability to treat inflammatory disease with topical rather than systemic therapies has obvious advantages. However, the rate of absorption from topical delivery is unknown, and current estimates are that five to 37 percent of topical fluid delivered is absorbed by the nasal mucosa,<sup>5</sup> the remainder being removed by mucociliary transport.

Much of the volume of nasally irrigated fluid is not retained in the nasal cavity and paranasal sinuses. The majority exits the contralateral nasal cavity. To date there are no data on the residual volume and percentage of fluid retained after nasal irrigation in patients. Quantification of the residual volume has important implications for the treatment of inflammatory disease of the nose and sinuses with saline, as well as for potentially novel topical therapies. That is, these objective measurements would be helpful in the rational prediction of drug exposure or absorption based on the volume of irrigation fluid retained in order to deliver novel agents therapeutically and safely. Many different delivery systems are available to deliver topical solutions to the nose (Table 1). This study characterizes the fluid properties of two common devices.

## METHODS

Three groups of participants were recruited: controls, CRS participants, and post endoscopic sinus surgery (ESS) participants. Healthy adult controls were defined as having no significant sinonasal symptoms; in addition, endoscopy was performed to exclude severe septal deviation, polyps, or other sinonasal pathology. CRS participants were defined as per European Position guidelines<sup>6</sup> and had been using topical saline as part of their treatment. Those defined as post-ESS participants had undergone bilateral maxillary antrostomy and sphenoidectomy at least four weeks previously. A combination of Draf 1 to 2b procedures had

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