Describing the Trends in Neck, Leg and Total Fluid Volumes in Patients Undergoing Non-Cardiac Surgery in the Perioperative Period – A Prospective Cohort Study

Presenting Author: Gincy Lukachan MD
Co-Authors: Azadeh Yadollahi PhD, Nayeemur Rehman MBBS, Stuart McCluskey MD, Douglas Bradley MD, Frances Chung MBBS, Mandeep Singh MD

University Health Network, University of Toronto, Toronto, Canada

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Background: The severity of OSA has been shown to increase postoperatively.[1] In the general population, IV administration of crystalloids has been shown to increase neck fluid volume, especially in older men, by the process of rostral fluid shift [2,3]. The changes in segmental fluid volume especially the neck fluid volume may be related to increasing airway collapsibility and thus worsening of OSA in the postoperative period. In this analysis of ongoing prospective cohort study, we hypothesized that in patients receiving general anesthesia (GA) and IV fluids after non-cardiac surgery trends in segmental fluid volumes will be different between males and females.

Methods: Following REB approval, adult patients ($\geq$18 yrs), ASA I-IV, undergoing elective inpatient surgery, were consented for this prospective cohort study in two major academic tertiary level hospitals. Patients underwent home sleep studies using a type 3 monitor to obtain the preoperative apnea-hypopnea index (AHI). On the day of surgery, the preoperative and postoperative fluid measurements for neck fluid volume (NFV), leg fluid volume (LFV) and total fluid volume (TFV) were recorded using bioelectrical impedance analysis (BIA).[3] Patients underwent GA and surgery as per the standard of care. All measurements were conducted with the patient in supine position in the pre-operative period (PreOp) before surgery, within 30 minutes of arrival to the post-anesthesia care unit (PACU), in the evening of the surgery (Night 1), and the next morning (Day 2). Primary outcome was NFV in the PACU and Day 2. Fluid changes across various time points were analyzed using the repeated measures ANOVA, and stratified based on sex. Multivariable linear regression analyses were performed for patients with or without moderate -severe OSA (AHI > 15) for covariates: age, sex, body position, preoperative apnea-hypopnea index (AHI) and total IV fluids received.

Results: Sixty-two of 345 screened patients consented for the study. Thirty-three patients undergoing laparoscopic general surgical, urological and gynecological surgeries with complete data were included in this analysis (Table 1). In the cohort, males were older with a lower BMI compared to females. There was no significant difference in the amount of fluids received or the fluid balance, preoperative AHI, or duration of surgery across sex.

Compared to preoperative values, NFV, LFV and TFV increased significantly in the PACU, and Day 2. (Figure 1) Compared to preoperative value (360 $\pm$ 162 ml, mean $\pm$ SD), NFV increase in the PACU (460 $\pm$ 171 ml, $p<0.05$) and Day 2(455$\pm$132 ml, $p<0.05$) in males. Also, in females, there was increase in the volume from Preop (289$\pm$77 ml) to

PACU (355±95 ml, p<0.05) and Day 2(340±98, p<0.05). In males, LFV significantly increased from Preop (3302 ± 611ml) to PACU (3385±670ml, p<0.05) and Day 2 (3672±720ml, p<0.05). In females, LFV significantly increased from Preop (3087 ± 831ml) to PACU (3189±901ml, p<0.05) and Day 2 (3423±951, p<0.05). TFV increased consistently from preoperative values to PACU and Day2 consistently for both groups. Multivariable linear regression analysis indicated significant predictors for NFV in PACU and Day 2 to be preoperative AHI and sex, respectively.

Conclusion: This is the first study to demonstrate variability of segmental fluid volumes in the perioperative period with differences across sex. It remains to be seen if the changes in NFV translate into worsening of upper airway collapsibility, increased OSA severity and worse cardiorespiratory complications in the perioperative period.

References:

1 Anesthesiology 2014;120:287–98
2 Anesth Analg 2016;122:1335–9..
3 Sleep 2014;37:1699–705.

Table 1. Demographic information of included patients.

Variable	Males (n = 15)	Females (n = 18)	P-Value
Age (yrs, mean ± SD)	58.33±12.11	53.94±11.54	0.2982
BMI (kg/m2, mean ± SD)	28.42±4.94	34.87±7.67	0.0068
Preoperative AHI (events/hr, mean ± SD)	11.45±11.80	15.05±11.91	0.391
Fluids Input at PACU (ml)	2287.67±968.56	1812.78 ±1061.84	0.1894
Fluids Input at Night 1 (ml)	881.87±390.67	798.17±320.13	0.59
Fluids Input at Day 2 (ml)	827.27±513.18	1086.74±355.04	0.08
Duration of Surgery (min, median [range])	253.47±111.12	235.71±111.36	0.640
OSA grading (AHI score)			
No OSA (0-5 events/Hr)	5	4	
Mild OSA (5-15 events/Hr)	7	7	
Moderate OSA (15-30 events/Hr)	1	3	
Severe OSA (>30 events/Hr)	2	4	
Type of Surgery			
Bariatric Surgery(number, percentages)	0	5(15.15%)	
General Surgery	4(12.12%)	5(15.15%)	
Urology	11(33.33%)	3(9.09%)	
Gynecology	0	5(15.15%)	

Legend: AHI: apnea-hypopnea index.

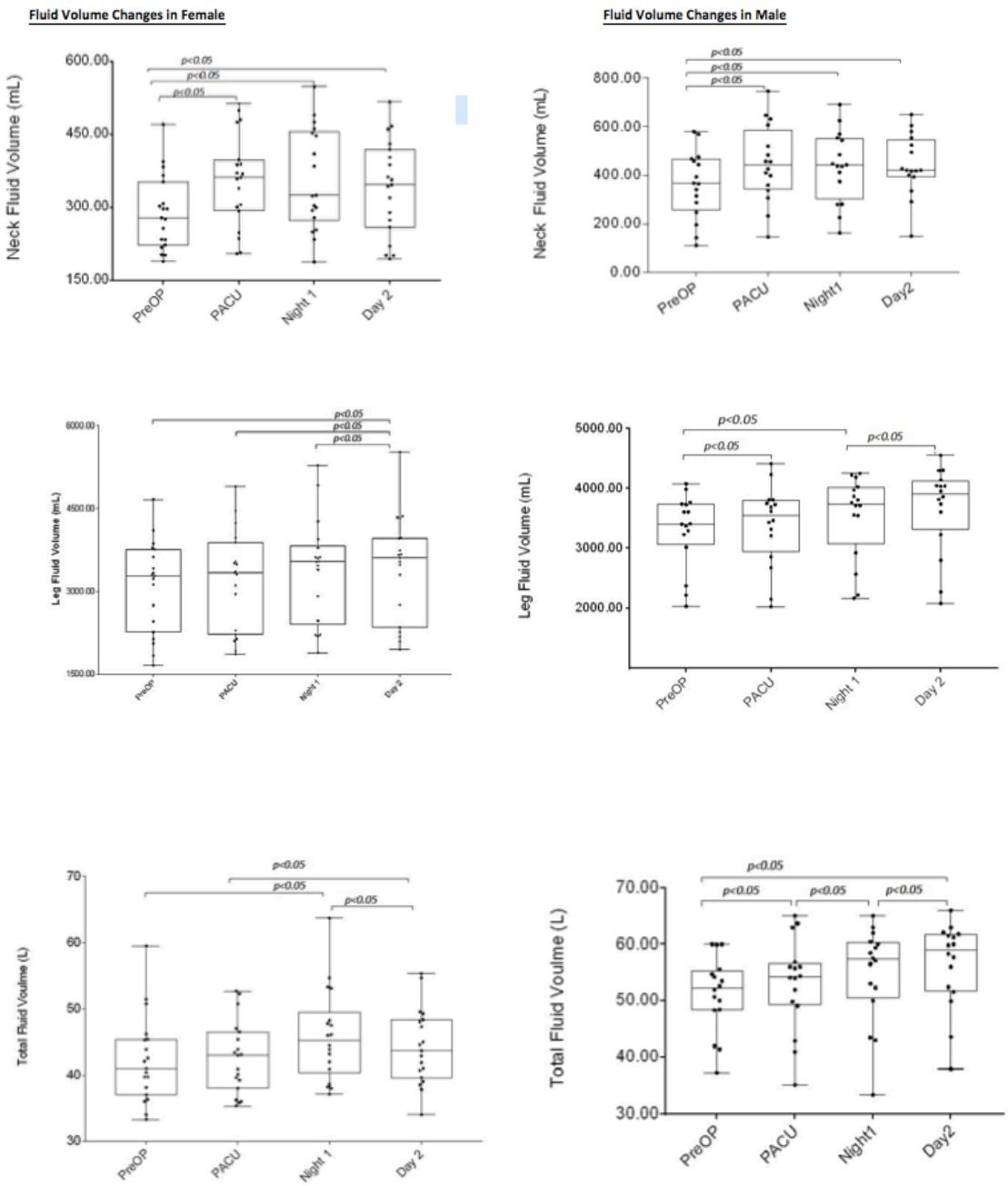

Figure 1. Postoperative changes in the neck fluid, leg fluid volume and total body water following general anesthesia - Group effects of time and gender using repeated measures ANOVA.

POCU: pre-operative care unit: PACU: Post-anesthesia care unit