# Lung Ultrasonographic Assessment of Volume Status in Hemodialysis Patients

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Background

➤ Volume status is a critical component of the clinical management of hemodialysis (HD) patients. Volume overload is a cause of hypertension in HD patients and an independent risk factor for death.

➤ IDH is a decrease in systolic blood pressure by ⩾20 mm Hg or mean arterial pressure by ⩾10 mm Hg, and is associated with cramping, nausea, vomiting & abdominal pain.

➤ Lung ultrasonography (LUS) relies on the presence of B-lines to represent extravascular lung water (EVLW).

➤ B-lines are hyperechoic lines on LUS running from the pleura to the edge of the screen with several unique features.

➤ Using LUS to guide DW targets can improve ambulatory blood pressure control without increasing IDH.

Soft Tissue · Superficial · Pleura · Rib Shadow · B-line · Deep
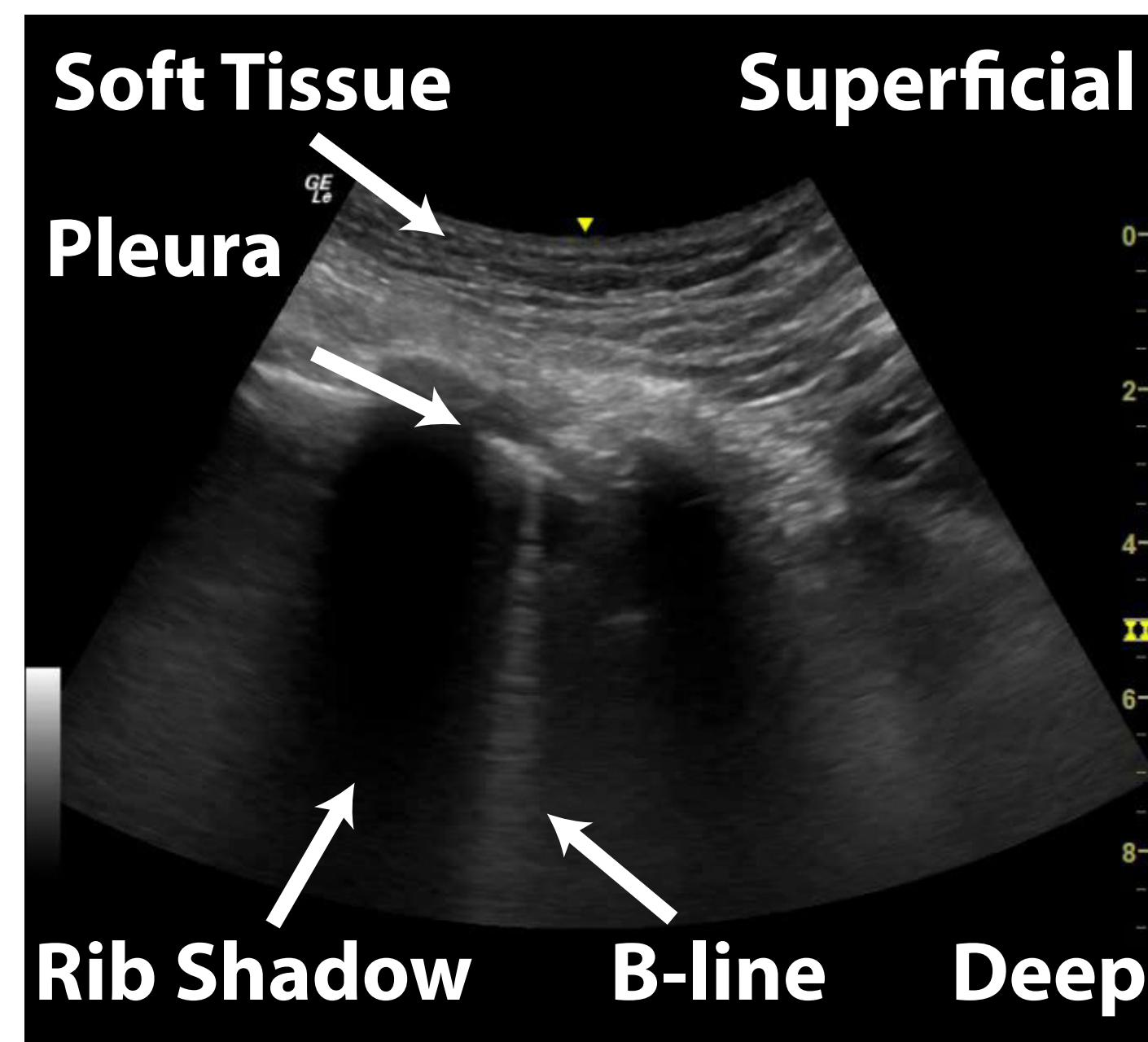
Example B-line

Aim

➤ Utilize LUS to find pulmonary congestion in HD patients and safely ultrafiltrate (UF) patients.
➤ Use LUS to identify patients with subclinical congestive heart failure
➤ Determine if brain natriuretic peptide (BNP) and the number of B-lines seen on LUS are correlated.

Methods

➤ 11 HD patients with a history of IDH were recruited.

➤ Patients were scanned in 28 locations.

➤ Data was analysed in Matlab where mean, standard deviation, statistical significance, and correlation coefficients were calculated.

Scan Locations

An Example Scan

➤ A baseline period assessed dry weight, probability and duration of IDH, systolic blood pressure (sBP), and patient characteristics.
➤ LUS was incorporated into the physical exam and decisions to challenge dry weight.

Results

➤ Fraction of time hypotensive was computed for each dialysis session and averaged for a single patient. The cohort of patients was then combined.

➤ Patients were followed for a median 7 (3) sessions retrospecively and a median 14 (15) sessions prospectively.

➤ Peridialysis weight was explored by averaging weights for 1 week prior to LUS and 1 week after LUS, allowing direct comparison after the intervention.

CHARACTERISTICS	
NUMBER OF PATIENTS	11
AGE (YEARS)	67 ± 15
MALE, N (%)	8 (72)
HEIGHT (CM)	172 ± 16
BMI (KG/M²)	35 ± 9
DIALYSIS VINTAGE, MO (MEDIAN, IQR)	18 (50)
HYPERTENSION, N (%)	10 (91)
RAAS BLOCKER, N (%)	6 (54)
BB / CCB, N (%)	10 (91)

RESULT	PRE-INTERVENTION (MEAN ± SD)	POST-INTERVENTION (MEAN ± SD)	P-VALUE
FOLLOW UP (DAYS)	14 ± 8	46 ± 21	-
PERCENTAGE OF TIME HYPOTENSIVE (%)	37 ± 8%.	25 ± 5%	0.03
PROBABILITY OF HYPOTENSION (%)	78 ± 7%	53 ± 6%	0.02
B-LINES (#)	20 ± 7	14 ± 3	0.02
WEIGHT (KG)	100 ± 9	100 ± 9	0.9
PERIDIALYSIS WEIGHT (KG)	102 ± 10	101 ± 10	1.0

Fraction of Time Spent Hypotension Before and After Intervention
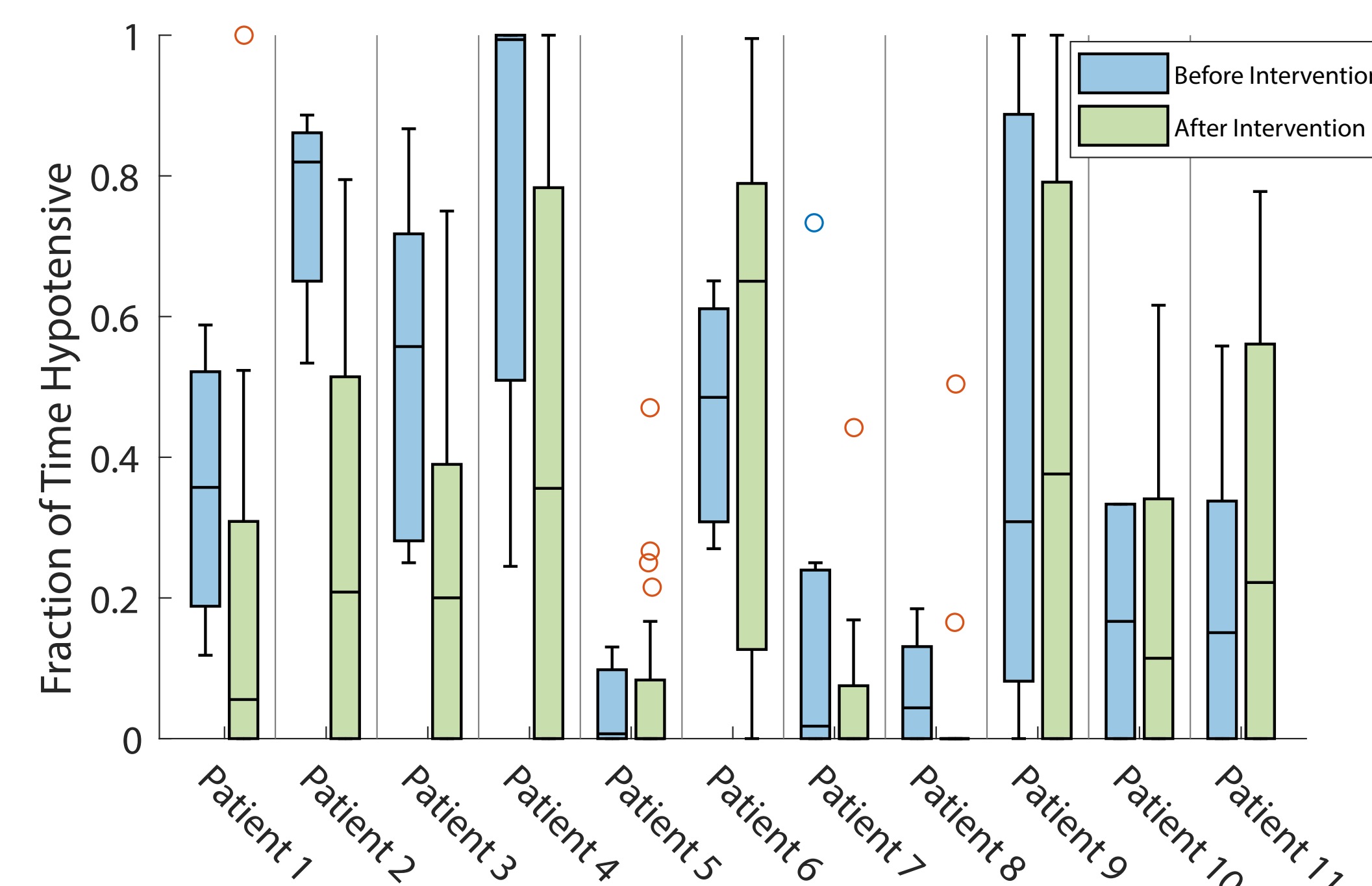
Box plot comparing intradialytic hypotension during the pre- and post- intervention period. Outliers are marked in circles.

Results Continued

➤ BNP values drawn within 48 hours of LUS were compared to investigate correlation. 25 measurements were compared.

➤ A correlation coefficient of -0.1 ± 0.2 (p = 0.5) was computed.

➤ There was a decrease in the average number of B-lines during the pre- and post-intervention period.

B-lines vs. BNP for 11 Patients

Total B-lines Before & After Intervention
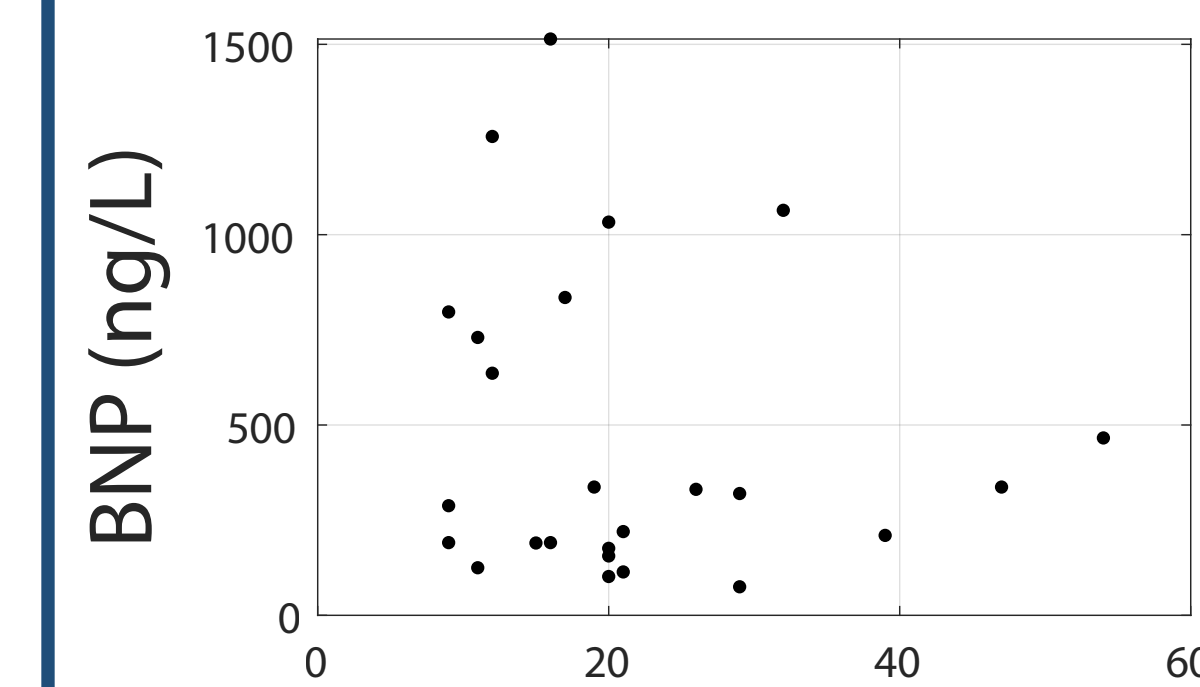
BNPs within 48-hours of B-line measurement. No statistical correlation observed.
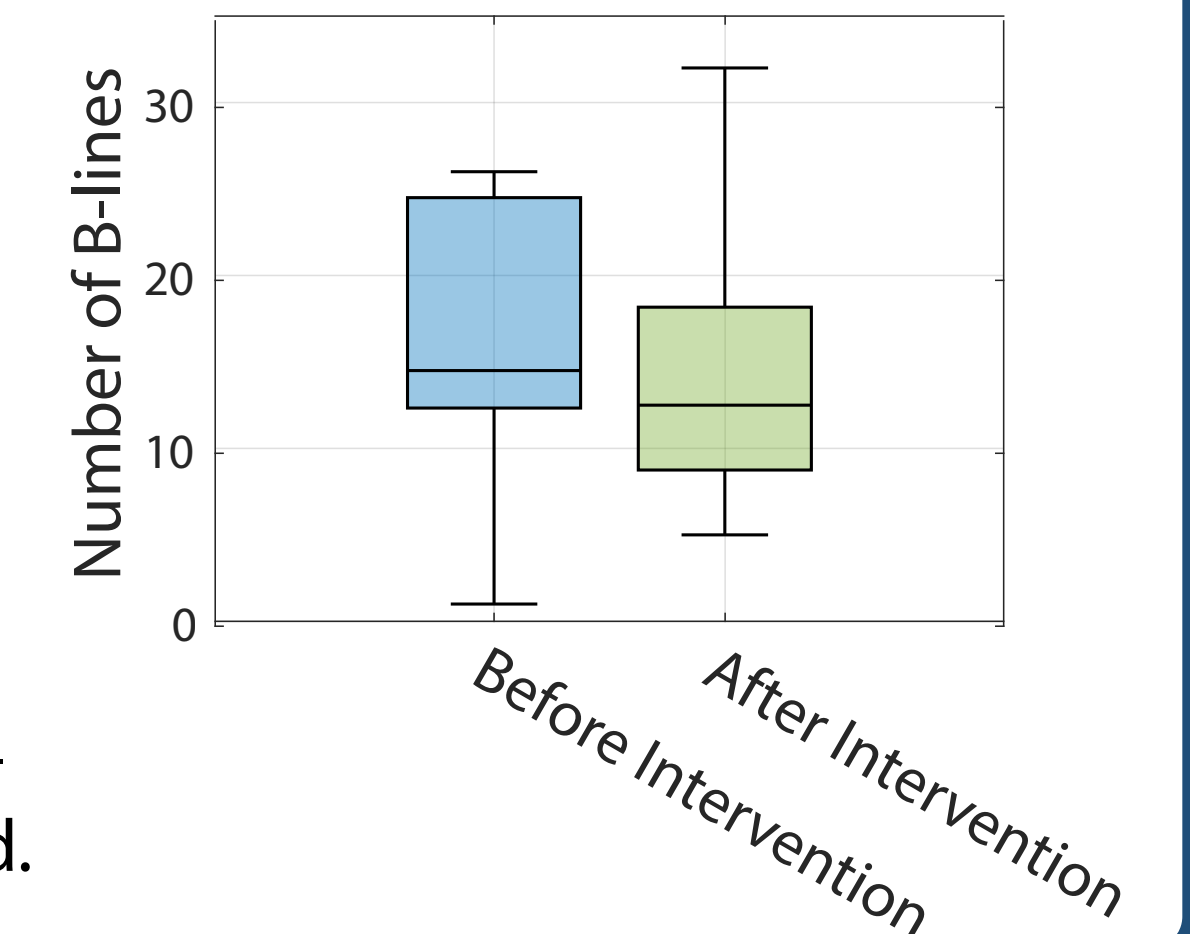
Discussion

➤ We implemented a new program at Kootenay Boundary Regional Hospital in Trail, BC
➤ Statistically significant **reduction** in:
  • Duration IDH among our HD patients.
  • Probability of encountering IDH
  • Number of B-lines shown on LUS

➤ Most patients were asymptomatic, indicating that we identified patients with subclinical volume overload

➤ No difference in dry weight before and after intervention

➤ No statistical correlation between serum BNP levels and US-B lines.

➤ A second cohort of study participants will start later in 2020.

Acknowledgements

UBC

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