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Authors

Sebreros, BA

Boswell, G

Lussier, AL

et al.

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A28-19 A Comparative Study of Lung Ultrasound and Chest X-Ray Findings in Military Trainees With Swimming-Induced Pulmonary Edema

B. A. Sebreros¹, G. Boswell¹, A. L. Lussier², P. Lindholm³, A. Ellis¹, S. Hughes¹

¹Naval Medical Center San Diego, San Diego, CA, United States

²University of California, San Diego, La Jolla, CA, United States

³University of California San Diego, San Diego, CA, United States

Corresponding author's email: bensebreros@gmail.com

Rationale: Swimming-induced pulmonary edema (SIPE) is a condition characterized by acute pulmonary symptoms during strenuous water activities, notably affecting military trainees and open-water swimmers. Unilateral pulmonary edema, often on the dependent side during lateral or side-down positions, suggests gravitational and regional perfusion influences. While chest x-ray (CXR) and lung ultrasound (LUS) are utilized for diagnosis, their comparative effectiveness, particularly in detecting lateralization, remains underexplored. The primary aims of this study are to compare CXR and LUS findings in patients with SIPE, determine whether the dependent side in water while performing combat sidestroke (CSS) correlates with unilateral imaging findings, and explore any differences in detection between these modalities. Addressing these objectives may improve diagnostic precision, deepen understanding of SIPE's underlying mechanisms, and guide more effective management of affected individuals in aquatic and military training environments.

Methods: A retrospective review of 82 maritime trainees with SIPE which assessed clinical, radiographic, and ultrasound data to confirm pulmonary edema and its laterality. This review also examines the relationship between side-down positioning during sidestroke and imaging abnormalities. Chest radiographs and lung ultrasounds were scored with a 5-point Likert scale for side predilection. Their concordance was analyzed alongside the influence of body position on chest imaging findings. The two Likert scales were compared for association, agreement, and directionality using Chi squared, Cohen's Kappa, and Spearman's rank correlation.

Results: A significant association was observed between CXR and LUS lateralization scores ($\chi^2=21.45$, $p<.001$), with moderate agreement ($\kappa=0.57$) and a strong positive correlation ($\rho=0.60$). When analyzing the full five-point scale, agreement improved ($\kappa=0.59$, $\rho=0.63$) (Table 1). A significant association was seen between lung edema lateralization on imaging and body position ($p < 0.001$).

Conclusion: This study demonstrates a moderate to strong concordance between chest radiography and lung ultrasound in detecting pulmonary edema lateralization in SIPE patients. Both modalities demonstrate significant correlation between dependent side-down positioning and unilateral edema. The study's focus on lateralization underscores the importance of positional factors during water activities. Recognizing dependence-related asymmetry in pulmonary edema suggests that positional strategies, such as switching sides during CSS, could help reduce SIPE risk. While LUS is a valuable tool

in the evaluation and diagnosis of SIPE, its limitations in identifying or characterizing more centrally located lesions or alternative pathologies should be acknowledged, as these may require complementary imaging modalities for comprehensive assessment.

Table 1. Comparison of lung ultrasound with chest radiograph findings in subjects with swimming-induced pulmonary edema, using Likert scores (1-5) to grade lateralization of imaging findings.

		CXR LIKERT SCORE				
		RIGHT		LEFT		
		CXR 1 ^a	CXR 2 ^a	CXR 3 ^a	CXR 4 ^a	CXR 5 ^a
LUS LIKERT SCORE	Right	US 1 ^b	2	0	0	0
		US 2 ^b	1	3	1	0
		US 3 ^b	5	4	7	1
	Left	US 4 ^b	0	1	0	6
		US 5 ^b	0	0	0	1

^aχ²= 40.25, P < .0072^c; κ=0.59, P < .001^c; ρ=0.63, P < .001^c
CXR, chest x-ray; LUS, lung ultrasound
^aCXR 1: entirely right-sided findings; CXR 2: predominantly right-sided findings; CXR 3: evenly distributed right and left-sided findings; CXR 4: predominantly left-sided findings; CXR 5: entirely left-sided findings.
^bLUS 1: entirely right-sided findings; LUS 2: predominantly right-sided findings; LUS 3: evenly distributed right and left-sided findings; LUS 4: predominantly left-sided findings; CXR 5: entirely left-sided findings.
^cChi square statistic of 40.25, p-value < .0072, demonstrates a significant association between chest x-ray and lung ultrasound scores; Cohen weighted Kappa statistic with moderate to substantial agreement (κ=0.59, p<.001) and a Spearman's rank correlation showing strong positive correlation (ρ=0.63, p<.001).
^dStatistically significant

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