CRITICAL CARE

LETTER

Is extravascular lung water index useful for the diagnostic accuracy of lung injury in patients with shock? We need more evidence

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See related research by Chew *et al.*, http://ccforum.com/content/16/1/R1

In the previous issue of *Critical Care*, I read with great interest the article by Chew and colleagues [1], who studied the role of extravascular lung water (EVLW) indices in improving the diagnostic accuracy of lung injury (LI) in patients with shock. It is not clear how the patients included in this study are different from those included in previous ones [2,3]. Indeed, in this work, 34 (67%) of patients had septic shock and up to 33 (65%) of patients presented with LI. Therefore, it is not proven that the results of this study could be extended to patients without septic shock and acute LI (ALI).

The authors provided only the values of likelihood ratios (LHRs) and post-test odds without their 95% confidence intervals (CIs). However, the reporting of CIs enables readers to effectively understand the values presented, taking into account the uncertainty inherent in any sample size. Likelihood and diagnostic ratios are ratios of probabilities but should also be reported with their CIs [4]. Thus, I calculated the 95% CIs of LHRs and post-test odds for each EVLW index (Tables 1 and 2). For LHRs, CIs that include 1 indicate that the study has not shown convincing evidence of any diagnostic value of the

Table 1. Likelihood ratios and their post-test odds of EVLW indices for a diagnosis of ALI, ARDS, or sLI

		ALI	95% CI	ARDS	95% CI	sLI	95% CI
EVLW/ABW	LHR^+	3.3	1.3-8.36	3.2	1.34-7.64	1.87	0.75-4.63
	LHR^-	0.6	0.37-0.94	0.56	0.32-0.97	0.73	0.4-1.33
	Pretest odds	0.55	-	0.42	-	0.21	-
	Post-test $odds^+$	1.80	0.8-4	1.33	0.63-2.84	0.40	0.16-0.98
	Post-test $odds^-$	0.32	0.18-0.58	0.23	0.12-0.46	0.16	0.07-0.36
EVLW/PBW	LHR^+	2.02	1.07-3.8	1.80	0.97-3.34	3.50	1.61-7.6
	LHR^-	0.56	0.3-1.02	0.60	0.31-1.14	0.41	0.16-1.05
	Pretest odds	0.56	-	0.42	-	0.21	-
	Post-test $odds^+$	1.10	0.6-2	0.75	0.4-1.39	0.75	0.35-1.6
	Post-test $odds^-$	0.30	0.15-0.6	0.25	0.12-0.52	0.09	0.03-0.26
EVLW/PBV	LHR^+	1.83	1.24-2.7	1.64	1.14-2.37	8.4	3.7-19.12
	LHR^-	0.22	0.05-0.84	0.28	0.07-1.1	0	-
	Pretest odds	0.55	-	0.42	-	0.21	-
	Post-test $odds^+$	1.00	0.61-1.63	0.68	0.41-1.14	1.79	0.8-4
	Post-test $odds^-$	0.12	0.03-0.44	0.12	0.03-0.44	0	-

The positive extravascular lung water (EVLW) test is defined as EVLW/ABW of greater than 10 mL/kg, EVLW/PBW of greater than 10 mL/kg, and EVLW/PBV of greater than 1.5. ABW, actual body weight; ALI, acute lung injury; ARDS, acute respiratory distress syndrome; CI, confidence interval; LHR, likelihood ratio; PBV, pulmonary blood volume; PBW, predicted body weight; sLI, severe lung injury.

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Table 2. Positive likelihood ratios and pretest and positive post-test odds for mortality given a positive EVLW test

		ALI alone	95% CI	Combined with ALI	95% CI	Combined with ARDS	95% CI	Combined with sLI	95% CI
EVLW/ABW	LHR+	1.83	1.02-3.3	2.27	0.92-5.57	1.89	0.72-4.97	4.4	1.21-16
	Pretest odds	0.38	-	0.38	-	0.38	-	0.38	-
	Post-test odds+	0.69	0.37-1.27	0.86	0.39-1.86	0.71	0.31-1.63	1.66	0.59-4.73
EVLW/PBW	LHR+	1.41	0.77-2.56	1.51	0.52-4.37	1.76	0.58-5.32	1.98	0.51-7.76
	Pretest odds	0.38	-	0.38	-	0.38	-	0.38	-
	Post-test odds+	0.53	0.28-1	0.57	0.23-1.4	0.67	0.27-1.66	0.75	0.26-2.18
EVLW/PBV	LHR+	2.11	1.05-4.24	1.76	0.58-5.32	2.11	0.57-8.62	3.52	0.9-13.8
	Pretest odds	0.38	-	0.38	-	0.38	-	0.38	-
	Post-test odds+	0.8	0.41-1.55	0.67	0.27-1.68	0.8	0.29-2.42	1.33	0.46-3.9

The positive extravascular lung water (EVLW) test is defined as EVLW/ABW of greater than 10 mL/kg, EVLW/PBW of greater than 10 mL/kg, and EVLW/PBV of greater than 1.5. ABW, actual body weight; ALI, acute lung injury; ARDS, acute respiratory distress syndrome; CI, confidence interval; LHR, likelihood ratio; PBV, pulmonary blood volume; PBW, predicted body weight; sLI, severe lung injury.

investigated variable [5]. In this study, almost all 95% CIs of LHRs included 1 or were not so far from 1. Moreover, the lower limits of 95% CIs of positive post-test odds were not so far from the values of pretest odds. Therefore, this study did not provide evidence that EVLW indices improve the diagnostic accuracy of LI in patients with shock.

Authors' response

Michelle S Chew, Lilian Ihrman, Joachim During, Lill Bergenzaun, Anders Ersson, Johan Undén, Jörgen Rydén, Eva Åkerman and Marina Larsson

We thank Mallat for his interest in our work [1]. We agree that CIs would be useful. In Tables 3 and 4, we present odds ratios (ORs) and their CIs for the diagnosis of LI and mortality, given a positive EVLW 'test', by using the method suggested by Bland and Altman [6].

Table 3 shows that the ORs for a diagnosis of LI increase with a positive EVLW test: positive test = EVLW/actual body weight (ABW) or EVLW/predicted body weight of greater than 10 mL/kg or EVLW/pulmonary blood volume of greater than 1.5. The ORs for mortality increase when a positive EVLW test is added to a diagnosis of ALI and acute respiratory distress syndrome (ARDS) (Table 4). The data are less clear for severe LI (sLI). Mallat's comment that CIs enable readers to take into account uncertainties in the data is relevant – the CIs are wide, as many of the frequencies used to calculate them were low. For example, there were only three patients with the combination of death, ARDS, and positive EVLW/ABW, resulting in high standard errors and wide CIs. Nevertheless, all data point in the same direction and, taken together, indicate that EVLW may be a useful test to further stratify patients with LI and at risk of dying.

Previous investigations have studied patients with septic shock or ALI/ARDS. The present population is different because it includes patients with shock, not just those with sepsis, ALI, ARDS, or sLI. The results cannot be extended to patients without shock. The percentage of patients who had LI was 18% to 35%, not 65% as mentioned by Mallat. Although our intention was to include a more heterogeneous population, two thirds of the patients in this study had sepsis. This was mentioned as a limitation in the Discussion [1]. It would be of interest to

Table 3. Odds ratios (95% confidence intervals) for a diagnosis of ALI, ARDS, or sLI given a positive EVLW test

	ALI	ARDS	sLI
EVLW/ABW	5.61 (1.49-21.16)	5.71 (1.49-21.85)	2.56 (0.58-11.43)
EVLW/PBW	3.62 (1.09-12.05)	3.0 (0.90-10.42)	8.52 (1.75-41.64)
EWLV/PBV	8.48 (1.68-42.86)	5.80 (1.14-29.49)	-

ABW, actual body weight; ALI, acute lung injury; ARDS, acute respiratory distress syndrome; EVLW, extravascular lung water; PBV, pulmonary blood volume; PBW, predicted body weight; sLI, severe lung injury.

Table 4. Odds ratios (95% confidence intervals) for mortality given a diagnosis of lung injury combined with an EVLW test

	ALI	ARDS	sLI
No EVLW test	1.91 (0.55-6.61)	2.00 (0.56-7.19)	5.34 (1.23-23.10)
EVLW/ABW	2.40 (0.50-11.53)	2.30 (0.42-12.45)	7.14 (1.08-47.42)
EVLW/PBW	2.43 (0.47-12.53)	2.38 (0.41-13.75)	4.41 (0.81-23.91)
EVLW/PBV	2.75 (0.52-14.44)	3.06 (0.53-17.46)	5.25 (0.97-28.28)

ABW, actual body weight; ALI, acute lung injury; ARDS, acute respiratory distress syndrome; EVLW, extravascular lung water; PBV, pulmonary blood volume; PBW, predicted body weight; sLI, severe lung injury.

test the reproducibility of these results prospectively in a population without septic shock.

Therefore, we believe that these results give some evidence for how EVLW may be used in future studies, perhaps as a tool for stratifying LI in patients with shock. We agree that more evidence is needed and hope that this contribution will generate further studies of the role of EVLW in critically ill patients.

Abbreviations

ABW, actual body weight; ALI, acute lung injury; ARDS, acute respiratory distress syndrome; CI, confidence interval; EVLW, extravascular lung water; LHR, likelihood ratio; LI, lung injury; OR, odds ratio; sLI, severe lung injury.

Competing interests

MSC has received travel reimbursements from Pulsion Medical Systems (Munich, Germany).

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