

## ORIGINAL ARTICLE

# Long-term functional and psychological recovery in a population of acute respiratory distress syndrome patients treated with VV-ECMO and in their caregivers

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## ABSTRACT

**BACKGROUND:** Acute respiratory distress syndrome (ARDS) survivors are affected with long-term physical/mental impairments, with improvements limited mostly to the first year after intensive care (ICU) discharge. Furthermore, caregivers of ICU patients exhibit psychological problems after family-member recovery. We evaluated the long-term physical and mental recovery of ARDS survivors treated with veno-venous extracorporeal membrane oxygenation (VV-ECMO), and the long-term psychological impact on their caregivers.

**METHODS:** Single-center prospective evaluation of a retrospective cohort of 75 ARDS patients treated with VV-ECMO during a seven-year period (25.10.2009-11.08.2016). Primary outcomes were the 36-Item Short-Form Health-Survey (SF-36, patients only), and risks of depression, anxiety or post-traumatic stress disorder (PTSD), both for patients and their caregivers. We investigated correlations between outcomes and population characteristics.

**RESULTS:** Of 50 ICU-survivors, seven died later and five were not contactable. Among 38 living patients, 33 participated (87%, 31 with their caregiver) with 2.7 years of median follow-up. Physical and mental SF-36 component scores were 42 (inter-quartile range, IQR:22) and 52 (IQR:18.5), respectively. The worst domains of the SF-36 were physical-role limitations (25, IQR:100) and general-health perception (56, IQR:42.5). Psychological tests highlighted high risk of depression (39-42%, patients; 39-52%, caregivers), anxiety (42%, patients; 39%, caregivers), and PTSD (47%, patients; 61%, caregivers). Patient depression or anxiety scores were correlated to age and to the outcome reported by caregivers.

**CONCLUSIONS:** At almost three-year follow-up, ARDS survivors treated with VV-ECMO showed reduced health-related quality-of-life and high risk of psychological impairment, in particular PTSD. Caregivers of this population were at high psychological risk as well.

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**KEY WORDS:** Patient health questionnaire; Critical care; Quality of life.

Acute respiratory distress syndrome (ARDS) is associated with high mortality and morbidity.<sup>1, 2</sup> Most patients are admitted to the In-

tensive Care Unit (ICU), and require prolonged mechanical ventilation (MV) and long ICU stay.<sup>1</sup> Importantly, MV can cause further lung damage,<sup>3</sup>

and the gold standard is protective lung ventilation strategy.<sup>4</sup> Several therapies have been evaluated, but only few have beneficial effects (e.g., early neuro-muscular blockade<sup>5</sup> and/or prone positioning<sup>6</sup>).

In severe refractory ARDS, support with veno-venous extracorporeal membrane oxygenation (VV-ECMO) is increasingly used.<sup>7</sup> A randomized controlled trial showed promising results in survival, which have been confirmed by systematic reviews,<sup>8,9</sup> but a recent multicenter randomized controlled trial conducted in patients with severe ARDS found only a trend toward reduction of 60-day mortality between early VV-ECMO (35%) vs. conventional treatment (46%,  $P=0.09$ ), though with a crossover to VV-ECMO backup in 28% of controls.<sup>10</sup>

Though overall ARDS survivors gradually improve over the first year after discharge,<sup>11</sup> their health-related scores are lower than the age- and gender-matched general population,<sup>12,13</sup> though possibly not different from other critical illness survivors.<sup>14</sup> Significant physical and psychosocial impairments are still detectable after five years.<sup>15,16</sup> ARDS survivors treated with VV-ECMO and surviving the first few months have good long-term survival (87%),<sup>17</sup> but there is paucity of long-term physical and psychological follow-up data.<sup>18-21</sup> Limited data suggest greater decrements in quality-of-life, but less psychological morbidity in survivors rescued with VV-ECMO compared with those treated with conventional MV.<sup>22</sup> Moreover, data on the follow-up of their caregivers<sup>23</sup> are scant, despite growing evidence on long-term impact of prolonged ICU stay and the subsequent strain from caregiving responsibilities.<sup>24</sup>

We conducted a single-center follow-up study to investigate the long-term recovery of ARDS survivors treated with VV-ECMO. We also evaluated the impact on their caregivers.

## Materials and methods

This is a retrospective single-center study with prospective evaluation of a cohort of consecutive adult ARDS patients treated with rescue VV-ECMO, admitted to our 14-bed ICU over a seven-year period. Institutional ethics approval for

follow-up studies was obtained (reference code: 88-ISMETT-2016), and all survivors provided written informed consent, agreeing to follow-up contacts.

At our institute there is no Emergency Department (ED), and case-mix is based on major abdominal, thoracic, and cardiac surgeries. We perform all solid organ transplants and have facilities to support, contemporaneously, up to seven ECMO patients, offering rescue for a vast area in the south of Italy. In this follow-up study we evaluated the long-term outcome (minimum one-year recovery period) of ARDS patients rescued with VV-ECMO (first admission: October 25, 2009; last included admission: August 11, 2016). Most studies are in agreement that this is the timeframe in which most of the recovery happens.<sup>11,12,16,25</sup> Cases of VV-ECMO before or after lung-transplant were excluded. Since all ARDS patients are referred to our Institute for extracorporeal support, we did not treat ARDS patients without VV-ECMO, and who could have been included in a control group.

We contacted patients from September 4, 2017 (maximum of five attempts per patient) to September 29, 2017, and in the case of acceptance to indicate their closest family member during the ICU stay (caregiver). According to preference, we delivered questionnaires *via*: 1) link (mobile/email); 2) email; 3) fax; 4) traditional mail delivery; 5) telephone interview.

We report scores of critical illness severity, duration of VV-ECMO support, days of MV (pre-, during-, after-ECMO, and overall), ICU and hospital stay, tracheostomy, and subsequent acute hospital admissions. With regard to the caregivers, we report age, gender, and relationship to the patient.

## Outcomes

Patient health-related quality of life (HR-QoL) was evaluated with the 36-Item Short-Form Health Survey (SF-36).<sup>26</sup> We report both the values for each of the eight domains, and the mean physical and mental component scores (PCS and MCS, respectively), which were calculated by averaging the respective domains (four each).

From psychological perspectives, patients were assessed with: 1) Hospital Anxiety and

Depression Scale (HADS, for risks of anxiety/depression);<sup>27</sup> 2) Centre for Epidemiologic Studies Depression (CES-D) for risk of depression;<sup>28</sup> and 3) Impact of Event Scale revised (IES-R) for symptoms of post-traumatic stress disorder (PTSD).<sup>29</sup> Predefined recommended cut-offs were used to assess risk of depression (CESD>15/60; HADS>7/21 points), anxiety (HADS>7/21 points), and PTSD (IES-R>21/88 points, while  $\geq 33$  points indicate likely presence of PTSD<sup>30</sup>). With regard to caregiver mental health, we evaluated the same questionnaires (HADS,<sup>27</sup> CES-D,<sup>28</sup> IES-R<sup>29</sup>). All these tests are validated in Italian.<sup>31-34</sup>

We investigated the patient-caregiver correlation in psychological scores, with the hypothesis of a positive correlation. For hypothesis-generating analyses we evaluated the correlation between PCS, MCS or psychological scores with the following: patient's age, severity scores, MV and VV-ECMO days.

**Statistical analysis**

We did not do a retrospective power calculation, and the sample size derived from what was available over the study time-period, as suggested by STROBE guidelines.<sup>35</sup> Statistical analyses were done using SPSS® Statistics17. Categorical variables are shown as number and percentage (%). Continuous variables are presented as mean±standard deviation for normally distributed data, or median and inter-quartile range (IQR) for not-normally distributed data. With regard to the psychological questionnaires, results are given as percentage of patients/caregivers at-risk. The correlations were investigated with the Pearson correlation coefficient (r, significance level P=0.05, two-tailed).

**Results**

Across a seven-year period we admitted 75 ARDS patients requiring VV-ECMO support. Twenty-five (33.3%) died in the ICU (N.=20 while on VV-ECMO, N.=5 afterwards), seven (9.3%) were dead at follow-up, and five (6.7%) were not contactable. Of the remaining 38 patients, three agreed to participate but never filled out the questionnaire, and two refused, leaving

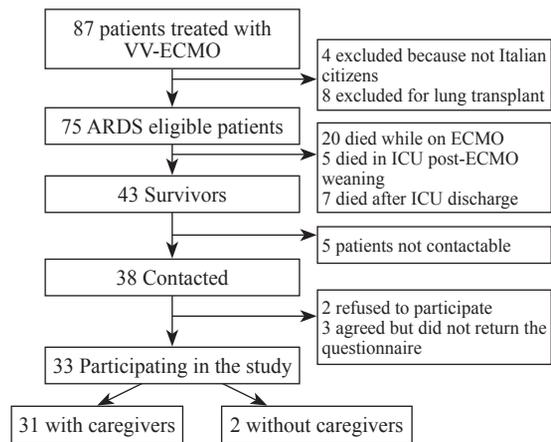


Figure 1.—Flowchart of the study. ARDS: acute respiratory distress syndrome; VV-ECMO: veno-veno extracorporeal membrane oxygenation.

a follow-up population of 33 patients (participation rate: 87%, range from two to 11 patients/year). All but two cases (divorced) participated with their caregiver (N.=31, Figure 1). The median follow-up period was 2.7 years (IQR 2.8; mean 3.7±2.2). Of the 33 patients, 20 (61%) had a diagnosis of H<sub>1</sub>N<sub>1</sub> influenza.

Table I illustrates the demographics and characteristics of participating ARDS patients. Most (N.=26/33, 79%) did not require subsequent hospital admissions during follow-up. The overall cohort of survivors (N.=38) had similar characteristics (Supplementary Digital Material 1: Supplementary Table I). Results of the SF-36 are listed in Table II, and also shown as radar plot together with normative data gathered from healthy individuals (49% male, mean age 47.7 years) of the Italian population published roughly 20 years ago (Figure 2).<sup>31</sup> Table III reports results of patient and caregiver psychological questionnaires. Depression risk, evaluated with two different tools (HADS and CES-D), was found in the ranges of 39-42% for patients, and 39-52% for their caregivers. Anxiety risk was around 40% in both populations, and an even higher number of individuals were also at PTSD risk (47% patients, 61% caregivers). The presence of PTSD using a higher cut-off was found in 9/33 patients (27%) and 14/31 caregivers (45%).

There was a significant correlation in psychological scores between patients and their caregivers, except for IES-R (CES-D r=0.52,

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TABLE I.—*Characteristics of the two studied populations. Acute respiratory distress syndrome survivors treated with rescue veno-venous extracorporeal membrane oxygenation (VV-ECMO) and their caregivers.*

Clinical characteristics	Population	Results
Patients (N.=33)		
Age on admission (years)		41.3±9.8
Gender (M, %)		24 (73%)
Length of stay (days)	Hospital pre-ECMO	4 (2-8)
	ICU pre-ECMO	2 (1-7)
	MV pre-ECMO	2 (1-4)
	VV-ECMO days (MV on ECMO)	10 (7-15)
	MV post-ECMO	9 (4-16)
	Total MV duration	23 (16-40)
Severity scores		
	SAPS II	37.3±11.3
	SOFA	8.1±3.2
	PaO <sub>2</sub> /FiO <sub>2</sub> (pre-ECMO)	57.5±10.6
	Preserve	4 (3-5)
	ECMONet	5.6±2.1
	RESP Score	4 (2-4)
	Charlson Comorbidity Index	0 (0-1)
Tracheostomy		23/33 (70%)
Hospital admission during follow-up period		
	No Admission	26/33 (79%)
	One admission	5/33 (15%)
	Two admissions	2/33 (6%)
	More than two admissions	0/33 (0%)
Caregivers (N.=31)		
Age at follow-up (years)		47.8±11.4
Gender (M, %)		45%
Relationship to patient		Mother/father: N.=9 Partner/wife/husband: N.=16 Son/daughter: N.=1 Brother/sister: N.=5

Continuous variables with normal distribution are presented as mean and standard deviation, while data not normally distributed are reported as median with first and third quartile.  
ICU: Intensive Care Unit; MV: mechanical ventilation; SAPS II: Simplified Acute Physiology Score; SOFA: Sequential Organ Failure Assessment (score).

TABLE II.—*Health-related quality of life questionnaire results for 33 acute respiratory distress syndrome survivors treated with rescue veno-venous extracorporeal membrane oxygenation (VV-ECMO).*

Variable	Result
Age on completion of questionnaire	45.0±9.8
Follow-up length (years)	Median 2.7 (IQR 2-5)
Follow-up rate (contactable)	33/38 (87%)
Questionnaire and domains	Median (1 <sup>st</sup> -3 <sup>rd</sup> quartile)
SF-36 (0-100)	
Physical functioning	70 (42.5-95)
Role limitations (physical)	25 (0-100)
Pain	74 (41-100)
General health perception	56 (39.5-82)
Vitality	65 (45-72.5)
Social functioning	87 (50-100)
Role limitations (emotional)	100 (0-100)
Mental health	72 (48-86)
Physical Component Score	42 (31-53)
Mental Component Score	52 (39-57.5)

According to their distribution, continuous variables results are presented as mean and standard deviation or as median with first and third quartile; categorical variables are reported as numbers and percentage.  
SF-36: The Short Form (36) Health Survey (Score from 0 to 100 points: the higher the score, the better the quality of life).

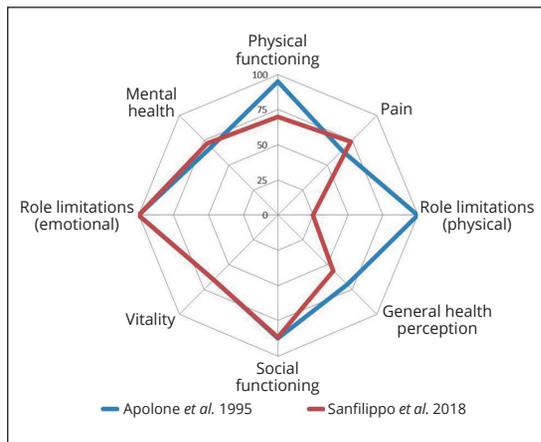


Figure 2.—Radar plot for results of SF-36 questionnaire. Gray line (blue in the online version) reports the results of our study. Black line (red in the online version) reports the results of Apolone *et al.*<sup>31</sup>

TABLE III.—Results of the psychological questionnaires in patients and in their caregivers. Two populations were investigated, 33 patients survived to acute respiratory distress syndrome survivors and treated with rescue veno-venous extracorporeal membrane oxygenation, and 31 caregivers.

Questionnaire	Median	Individuals at risk (%) [cut-off used]
<b>Patients (N.=33)</b>		
CES-D (up to 60) *	13 (9-24.5)	39% [>15 points]
HDAS-Anxiety (up to 21)	6 (3-11.5)	42% [>7 points]
HDAS-Depression (up to 21)	5 (2-9.5)	42% [>7 points]
IES-R (up to 88)	21 (9-33.5)	47% [>21 points] 27% [>32 points]
<b>Caregivers (N.=31)</b>		
CES-D (up to 60)	16 (9-25.5)	52% [>15 points]
HDAS-Anxiety (up to 21)	6.5 (4-12.5)	39% [>7 points]
HDAS-Depression (up to 21) *	5.5 (2-9)	39% [>7 points]
IES-R (up to 88)	34.50 (14-44.25)	61% [>21 points] 45% [>32 points]

Results of continuous variables are presented as median with first and third interquartile in brackets. CES-D: Center for Epidemiologic Studies Depression Scale; HDAS: Hospital Depression and Anxiety Scale; IES-R: Impact of Event Scale Revised. For each scale, the maximum score is indicated in brackets. In the last column the rate of patients/caregivers at risk of psychological issues is indicated according to a predefined cut-off.

P=0.02; HADS-depression  $r=0.60$ ,  $P<0.0001$ ; HADS-anxiety  $r=0.49$ ,  $P=0.005$ ; IES-R  $r=0.20$ ,  $P=0.34$ ; parallel graphs provided as Supplementary Digital Material 2: Supplementary

Figure 1). We found a significant correlation between patient age and results of CES-D ( $r=0.36$ ,  $P=0.04$ ), HADS-depression ( $r=0.47$ ,  $P=0.006$ ), and HADS-anxiety ( $r=0.40$ ,  $P=0.02$ ). No statistically significant correlation was found between caregiver's age and test results. The results on the correlation between patient questionnaire outcomes on one side, and MV total days, VV-ECMO days or severity scores are reported in Supplementary Digital Material 3 (Supplementary Table II). Most results were not statistically significant.

### Discussion

The largest follow-up investigation conducted on ARDS patients treated with VV-ECMO is the multicenter PRESERVE Study, which reports the long-term outcome of 67 patients.<sup>18</sup> We report the largest single-center investigation of the long-term outcomes of such patients, and the first evaluation of long-term impact on their caregivers.

At median follow-up of almost three years, we found impairments prevalently at the physical level in ARDS survivors (PCS: 42), while the mental impairment seemed lower (MCS: 52). The physical impairment is clear when comparing our results with normative data of the Italian healthy population (Figure 2), though such data were collected about two decades before ours.<sup>31</sup> Table IV summarizes our SF-36 results, comparing them with other four studies conducted in similar populations<sup>18-21</sup> though these had shorter follow-up (8-months,<sup>19</sup> 1-year<sup>20, 21</sup> or 17 months<sup>18</sup>). The largest one<sup>18</sup> reported similar SF-36 results (median PCS: 45 and MCS: 50).

Luyt *et al.*<sup>21</sup> and Hodgson *et al.*<sup>19</sup> reported lower SF-36 scores, but their shorter follow-up and smaller population warrant caution in the comparison. Luyt *et al.* enrolled 12 patients (two not receiving VV-ECMO<sup>21</sup>) with H<sub>1</sub>N<sub>1</sub>-related ARDS,<sup>21</sup> a condition associated with better outcomes.<sup>9, 36</sup> Wang *et al.*<sup>20</sup> reported higher SF-36 scores, but our population seems much sicker (Table IV). Interestingly, though the SF-36 mental score in our population was in the normal range, and similar to those reported in the Italian population.<sup>31</sup> We found a consistent risk of

TABLE IV.—Comparison of the results of health-related quality of life (Short-Form 26: SF-36) questionnaire. The table presents comparison between our study and the other four published in acute respiratory distress syndrome survivors treated with rescue veno-venous extracorporeal membrane oxygenation. Even with data not normally distributed we report also mean value to facilitate comparison.

Study characteristics	Sanfilippo <i>et al.</i> (present study)	Schmidt <i>et al.</i> <sup>18</sup>	Wang <i>et al.</i> <sup>20</sup>	Hodgson <i>et al.</i> <sup>19#</sup>	Luyt <i>et al.</i> <sup>21# **</sup>
Study site	Single center	Multicenter	Single center	Single center	Single center
Patient population (N.)	33	67	24	15	12
Age (years)	41	37*	38	36	35
PaO <sub>2</sub> /FiO <sub>2</sub>	Mean 57.5 Median 56	Median 53*	Mean 68.3	Median 69	Median 73.5
MV days	Mean 33.9	Median 40*	Median 10	Median 15.3	Median 36
Follow-up length (years)	Median 2.7 Mean 3.7	Median 1.4	Mean 1	Median 0.7	Median 1
Follow-up rate	33/38 (87%)	67/84 (80%)	24/26 (92%)	15/17 (88%)	12/16 (80%)
SF 36 Questionnaire	Mean    Median	Median	Mean	Mean	Median
Physical functioning	65    70	75	81	60	82
Role limitations (physical)	47    25	50	58	45	62
Pain	68    74	74	83	60	67
General health perception	60    56	60	65	43	55
Vitality	61    65	55	78	37	52
Social functioning	75    87	88	81	40	72
Role limitations (emotional)	67    100	100	80	60	65
Mental health	66    72	72	77	55	65
Physical Component Score	41    42	45	72	Not reported	Not reported
Mental Component Score	48    52	50	79	35.9	Not reported

#The results of these two studies were taken from visual analysis of graphs; \*these results are shown in the overall survivors (N.=84, not in the follow-up population); \*\*out of 12 patients, 10 were supported by VV-ECMO and two by pump-less extracorporeal lung assist device.

psychological morbidity (anxiety, depression, and PTSD at 42%, 42%, and 47%, respectively), worse than in the PRESERVE study (34%, 25%, and 16%, respectively<sup>18</sup>). Indeed, we found significant psychological issues both in patients and caregivers: patients showed risks of depression or anxiety in the order of 40%, and almost half seemed at risk of PTSD. For example, Luyt *et al.*<sup>21</sup> reported higher risk of depression (50%), lower anxiety (28%), and similar PTSD (41%). Summarizing these results, it seems that ARDS patients supported with rescue VV-ECMO have good survival but suffer from impaired long-term physical and psychological impairment.

The comparison with non-ECMO ARDS patients is challenging. The landmark studies by Herridge *et al.*<sup>11, 16</sup> included an older population of ARDS patients with shorter MV period (21 days) at three-year reported mean PCS and MCS of 39 and 44, respectively. Considering a difference of 5 points as significant,<sup>37</sup> PCS results are similar to ours (42), while our MCS score (52) may indicate better mental outcome. Likewise, another study<sup>15</sup> reporting long-term follow-up

(median 5.5 years) in 50 ARDS patients showed similar PCS (44), but worse MCS (42) results. Whether (and why) support with VV-ECMO offers better long-term mental outcomes in ARDS should be evaluated by large multicenter studies.

Since ARDS patients who remember multiple traumatic episodes have increased PTSD risk (41%) and lower HR-QoL compared with those reporting no/one adverse episode (PTSD incidence 9%),<sup>38</sup> we attempted to explain higher PTSD risk in our population with the hypothesis of possibly greater number of traumatic episodes. However, we found no correlation between PTSD risk and either overall MV or VV-ECMO days.

Compared to patients, caregivers showed similar anxiety risk and slightly higher depression risk. According to different cut-offs of the IES-R questionnaire, the risk for, and the presence of, PTSD were detected in 61% and 45% of caregivers, respectively. The prevalence of caregivers' depression (52%) was slightly higher than recently reported by the largest study on ICU caregivers.<sup>24</sup> However, that study included caregivers

of patients receiving at least 7-days MV, while our cohort was ventilated for much longer. Such data are worrisome considering that they refer to a young adult population. Interestingly, a direct correlation for risks of depression/anxiety was found between patient and caregiver, supporting the concept of “post-ICU family syndrome.”

While recent data show a 46% hospital mortality for severe ARDS,<sup>1</sup> evidence suggests pooled hospital-mortality of 38% for ARDS treated with VV-ECMO,<sup>9</sup> similar to the findings of the EOLIA trial.<sup>10</sup> We achieved slightly lower mortality at ICU-discharge (33%). Considering the low PaO<sub>2</sub>/FiO<sub>2</sub> ratio pre-ECMO (57) this finding seems promising, though probably favored by young age, large number of H<sub>1</sub>N<sub>1</sub>-ARDS patients, and by a low incidence of major complications.<sup>39</sup> Interestingly, most survivors were still alive at follow-up (84%), in line with recently reported results.<sup>17</sup> Moreover, we found remarkable that most survivors did not require subsequent hospital admissions during follow-up, and most of the remaining ones had only a single admission. This seems to be in contrast with a two-year follow-up study, where one-quarter of health care costs of ARDS survivors was consumed after initial discharge (readmissions and rehabilitation<sup>12</sup>).

Though rescue treatment with VV-ECMO improves hemodynamic stability and gas exchanges during critical illness, and also decreases ventilator-associated lung injury, we found profound physical and psychological long-term impact in ARDS survivors treated with VV-ECMO (and in their caregivers). However, it is possible that VV-ECMO increases short-term survival of patients who would have otherwise died, with the drawback of greater functional and psychological impairment. More research is needed to understand the potentialities of rescue VV-ECMO for severe ARDS in the long-term, and also whether physical/mental impairments are related to the underlying disease (ARDS) and/or support (VV-ECMO), or to the negative impact of long ICU-stay. Nonetheless, it seems reasonable to create pathways of care that support the recovery from critical illness, and multidisciplinary longitudinal interventions, including those for caregivers.

### Limitations of the study

Our study has several limitations. Principal is the absence of a control group of ARDS patients not supported with VV-ECMO (lack of ED at our institute). Patients receiving VV-ECMO are sicker, and pair-matching would be challenging, but may provide some clues.

Though a “selection bias” is unlikely given the high participation rate, its importance in follow-up studies cannot be overemphasized since only higher-functioning patients may agree to participate, falsely smoothing the disabilities spectrum.

Our study lacks longitudinal assessment, with no data on the trend of recovery. We are currently planning longitudinal follow-up. Nonetheless, ARDS patients show improvements in HR-QoL mostly during the first year,<sup>11, 12, 16, 25</sup> and a decline between first and second year has also been described.<sup>25</sup>

We limited the number of tests to encourage participation. The SF-36 questionnaire was chosen because is the most commonly reported in ARDS,<sup>40</sup> and currently the recommended one for the assessment of ICU survivors.<sup>41</sup> Physical domains of SF-36 have good correlation with six-minute walking-distance test<sup>11</sup> and spirometry,<sup>13</sup> possibly performing better than other questionnaires.<sup>13</sup>

At the time of VV-ECMO referral, it was difficult to assess pre-ICU health status. Physical and psychological profiles at baseline are important determinants of outcome after discharge. Pre-ICU admission frailty is associated with worse survival and higher disability;<sup>42</sup> moreover, health trajectory pre-ICU admission is associated with recovery,<sup>43</sup> but we could not evaluate these confounders. However, the study population was relatively young and their Charlson Comorbidity Index scores support a relatively good pre-ICU status (predicted 10-year survival above 96%). To the best of our knowledge no patient was receiving psychotropic drugs before hospital admission, though we do not have absolute certainty regarding this.

### Conclusions

In a population of ARDS survivors treated with rescue VV-ECMO and with prolonged ICU stay,

at almost three years follow-up we found reduced health-related quality-of-life and a high risk of psychological morbidity, in particular of PTSD. Caregivers of this population of patients were at high psychological risk too. Though baseline physical and psychological conditions were unknown and more research is warranted on these long-term outcomes, it is probably worth considering implementation of pathways for recovery and rehabilitation in these two populations of individuals.

### What is known

- ARDS survivors are affected by long-term physical and mental impairments. Moreover, caregivers of ICU patients show psychological impairments after family-member recovery. Scant data are available on ARDS survivors treated with rescue VV-ECMO, and none on their caregivers.

### What is new

- ARDS survivors supported by rescue VV-ECMO have reduced HR-QoL and a high risk of psychological morbidity, in particular of PTSD, at almost three years follow-up.
- Caregivers of ARDS survivors treated with rescue VV-ECMO were at high psychological risk, with over 60% of them at risk of PTSD.
- Considering the likelihood of long-term impact on patients and their caregivers it seems reasonable to consider the implementation of pathways for recovery and rehabilitation in these populations of individuals.

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