ASK THE QUESTION

Question(s): In patients admitted to the ICU on Extracorporeal Membrane Oxygenation (ECMO), are physical therapy and early mobilization safe and feasible?

SEARCH FOR EVIDENCE

Databases: PubMed, Scopus, CINAHL


Keywords: "Extracorporeal Membrane Oxygenation", ECMO, Physical Therapy", physiotherapy, rehabilitation, mobilization, mobility, ambulation, “Intensive Care”, ICU

CRITICALLY ANALYZE THE EVIDENCE

There were five studies found addressing the use of early mobilization and active physical therapy on patients admitted to the ICU on ECMO. One of the studies (Polastri et al., 2015) was a systematic review of 9 case series/case reports and small retrospective studies. Polastri and colleagues found that physiotherapy typically began within 2-5 days of ICU admission, with a higher percentage of patients on ECMO as bridge to lung transplant ambulating vs patients on ECMO as bridge to recovery (61% vs 24%). The average number of physiotherapy sessions was similar between these two groups, with 11.4 and 11.3 sessions, respectively. Similarly, three other studies (Ko et al., 2015; Lee et al., 2015; Pruijsten et al., 2014) found that physical therapy was safe and effective; however, safety events did occur in 5-13% of patients.
Bain et al., (2016) looked at the cost impact of early mobilization and physical therapy in patients on ECMO. The study found that patient cost was reduced when physical therapy was completed during ECMO. Post-transplant ICU cost (median: $143,407 vs $43,929; p=0.02) and total costs (up to 12 months after discharge) were significantly lower in the ambulatory group (median: $300,307 vs $244,508; p=0.02).

### PICO Question

**In patients admitted to the ICU on Extracorporeal Membrane Oxygenation (ECMO), are physical therapy and early mobilization safe and feasible?**

<table>
<thead>
<tr>
<th>Author/Date/ Journal</th>
<th>Purpose of Study</th>
<th>Study Design</th>
<th>Sample&amp; Setting</th>
<th>Outcomes</th>
<th>Design Limitations</th>
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<tbody>
<tr>
<td>Polastri et al., 2015, Physiotherapy research international</td>
<td>To assess the characteristics and potential advantages of physiotherapeutic interventions in subjects on awake ECMO support</td>
<td>Systematic review</td>
<td>9 studies (52 patients) -retrospective cohorts and case reports/series</td>
<td>Physiotherapy began within 2-5 days in almost all patients. 61% of patients on ECMO as bridge to lung transplantation (BTLT) ambulated vs. 24% of patients on ECMO as bridge to recovery (BTR). Average number of PT sessions for BTLT and BTR patients was 11.4 and 11.3, respectively. Mobilization used included: passive/active movement, postural changes, sitting/upright in bed, and ambulation</td>
<td>Study Limitations = None</td>
</tr>
<tr>
<td>Bain et al., 2016, Respiratory Care</td>
<td>To assess the economic impact at a single center of ambulatory versus non-ambulatory ECMO strategies as a bridge to lung transplantation</td>
<td>Retrospective cohort analysis</td>
<td>9 consecutive patients supported with ECMO in as a bridge to lung transplantation at a university hospital in NC -4 historical controls (ECMO, no rehab/ambulation) -5 study group (ECMO with active physical rehab including ambulation; 1 patient excluded due to re-transplantation with 8 mo)</td>
<td>Post-transplant mechanical ventilation duration was significantly shorter in the ambulatory group (median: 29.5 days vs 2 days; p=0.01), as was post-transplant ICU stay (median: 45 days vs 8 days; p=0.001). Cost: Pre-transplant cost was higher in the ambulatory group, but not significantly different (median: $52,124 vs $98,460; p=0.14) Post-transplant ICU cost were significantly lower in the ambulatory group (median: $143,407 vs $43,925; p=0.02) Post-ICU through discharge</td>
<td>Study Limitations = None</td>
</tr>
</tbody>
</table>

**GRADE CRITERIA for rating a body of evidence**

(See Appendix A for more info)

- **Lower Quality Rating if:**
  - Studies inconsistent (When there are differences in the direction of the effect, populations, interventions or outcomes between studies)
  - Studies are indirect (Your PICO question is quite different from the available evidence in regard to population, intervention, comparison, or outcome)
  - Studies are imprecise (When studies include few patients and few events and thus have wide confidence intervals and the results are uncertain)
  - Publication Bias (e.g. pharmaceutical company sponsors study on effectiveness of drug)

- **Increase Quality Rating if:**
  - Large Effect

**Level of evidence**

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<table>
<thead>
<tr>
<th>Ko et al., 2015, ASAIO Journal</th>
<th>To describe one hospital’s experience of physical therapy and active mobilization for patients on extracorporeal membrane oxygenation (ECMO) in terms of its technical feasibility and safety</th>
<th>Retrospective case review</th>
<th>8 patients who received physical therapy while on ECMO at a medical center in Korea</th>
</tr>
</thead>
</table>

- non-essential therapies disconnected during physical therapy
- mobility: 1) passive range of motion (PROM) of extremities and electrical muscle stimulation (EMS) in supine, 2) sitting in reclined bed with the head and trunk upright or on the edge of the bed, 3) strengthening using elastic band in sitting position, 4) standing out of bed or marching in place with or without

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<th>Cost included: surgical, equipment, pharmacy, lab, personnel, radiation, transfusion and inpatient room charges (actual cost data)</th>
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</table>

- Categories: pre-transplant, post-transplant ICU, post-ICU to discharge, total hospital cost (30d prior to initial discharge), total cost (30d prior to 12 months after initial discharge)

<table>
<thead>
<tr>
<th></th>
<th>costs were lower in the ambulatory group, but not significantly different (median: $27,541 vs $15,544; p=0.25)</th>
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</table>

- Total hospital costs were lower in the ambulatory group, but not significantly different (median: $273,294 vs $209,590; p=0.80)
- Total costs (up to 12 months after discharge) were significantly lower in the ambulatory group (median: $300,307 vs $244,508; p=0.02)

<table>
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<tr>
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<th>for studies as a whole:</th>
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- High
- Moderate
- Low
- Very Low

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<th>Study Limitations =</th>
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<td>Non-Experimental/Observational Studies (case-control, cohort, cross sectional, longitudinal, descriptive, epidemiologic, case study/series, survey)</td>
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- Insufficient sample size
- Sample not representative of patients in the population as a whole
- Variables (confounders, exposures, predictors) were not described
- Outcome criteria not objective or were not applied in blind fashion
- Insufficient follow-up, if applicable
- For prognostic study, sample not defined at common point in course of disease/condition
- For diagnostic study, gold standard not applied to all patients
- For diagnostic study, no independent, blind comparison between index test and gold standard
| Lee et al., 2015, *Journal of Critical Care* | To evaluate risk factors for potential safety events during mobility physical therapy sessions in the medical ICU | Retrospective case review | 99 patients admitted to a medical ICU at a hospital in Korea - 9 received ECMO during their ICU stay - mobility: (1) in-bed exercise such as PROM or AROM, (2) sitting, (3) transfer training from bed to chair, (4) standing, and (5) walking | 4 patients on ECMO experienced 9 potential safety events (13.0%; 95% CI, 6.5%-23.8%) during 69 mobility PT sessions with ECMO - 4 patients' intolerance (44.4%; 95% CI 15.3%-77.3%) - 2 tachypnea (22.2%; 95% CI 4.0%-59.8%) - 2 desaturation (22.2%; 95% CI 4.0%-59.8%), - 1 tachycardia (11.1%; 95% CI 0.6%-49.3%) | Study Limitations = □ None *Non-Experimental/Observational Studies (case-control, cohort, cross sectional, longitudinal, descriptive, epidemiologic, case study/series, survey)* □ Insufficient sample size □ Sample not representative of patients in the population as a whole □ Variables (confounders, exposures, predictors) were not described □ Outcome criteria not objective or were not applied in blind fashion □ Insufficient follow-up, if applicable □ For diagnostic study, sample not defined at common point in course of disease/condition □ For diagnostic study, gold standard not applied to all patients □ For diagnostic study, no independent, blind comparison between index test and gold standard |
| Pruijsten et al., 2014, *Intensive Care Medicine* | To assess the use of a custom-made ECMO helmet to promote active physical therapy while minimizing ECMO flow | Case series | 6 patients at 1 center undergoing active physical therapy during ECMO - mobilization: at least sitting in bed upright with both legs hanging outside of bed | Four patients were able to stand and walk a short distance (up to 100 m) and two patients could sit upright with both legs hanging outside of the bed. Mobilization of all patients was uncomplicated. ECMO cannulas did not need to be held by hand and did not dislocate in any patient during mobilization. | Study Limitations = □ None *Non-Experimental/Observational Studies (case-control, cohort, cross sectional, longitudinal, descriptive, epidemiologic, case study/series, survey)* □ Insufficient sample size □ Sample not representative of patients in the population as a whole □ Variables (confounders, exposures, predictors) were not described □ Outcome criteria not objective or were not applied in blind fashion □ Insufficient follow-up, if applicable □ For diagnostic study, sample not defined at common point in course of disease/condition □ For diagnostic study, gold standard not applied to all patients □ For diagnostic study, no independent, blind comparison between index test and gold standard |
REFERENCES


Appendix A: GRADE criteria for rating a body of evidence on an intervention
Developed by the GRADE Working Group

Grades and interpretations:
High: Further research is very unlikely to change our confidence in the estimate of effect.
Moderate: Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate.
Low: Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.
Very low: Any estimate of effect is very uncertain.
### Type of evidence and starting level

<table>
<thead>
<tr>
<th>Type of evidence</th>
<th>Starting level</th>
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<tbody>
<tr>
<td>Randomized trial</td>
<td>High</td>
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<tr>
<td>Observational study</td>
<td>Low</td>
</tr>
<tr>
<td>Any other evidence</td>
<td>Very low</td>
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</tbody>
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### Criteria for increasing or decreasing level

**Reductions**
- Study quality has serious (−1) or very serious (−2) problems
- Important inconsistency in evidence (−1)
- Directness is somewhat (−1) or seriously (−2) uncertain
- Sparse or imprecise data (−1)
- Reporting bias highly probable (−1)

**Increases**
- Evidence of association† strong (+1) or very strong (+2)
- Dose-response gradient evident (+1)
- All plausible confounders would reduce the effect (+1)

†Strong association defined as significant relative risk (factor of 2) based on consistent evidence from two or more studies with no plausible confounders. Very strong association defined as significant relative risk (factor of 5) based on direct evidence with no threats to validity.