Regional Anesthesia in Microgravity: A Scoping Review

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INTRODUCTION

~6% annual risk of medical emergency per crew member in space[1].

Microgravity → physiological changes, limited resources, airway management challenges[2].

Regional Anesthesia (RA) may be an alternative, but its applicability in spaceflight remains unclear.

This scoping review maps existing literature on regional anesthesia in microgravity and identifies knowledge gaps.

METHODS

Databases Searched
(from inception to July 2026)

PubMed, Scopus, Embase, Web of Science

1469 records screened

69 reports assessed for eligibility

25 articles + 1 ongoing trial included in review

Search Terms related to:
- Anesthesia, Local and Regional
- Nerve blocks
- Microgravity or Spaceflight

Inclusion Criteria
-Physiological.Pharmacological considerations for RA
-Applicability of RA in microgravity

Exclusion Criteria
-GA or airway management only
-Spaceflight physiology only

Only published data was used, IRB approval was not required.

RESULTS

26 papers met inclusion criteria

23 reviews | **1 book chapter** | **1 proof-of-concept study** | **1 ongoing trial**

Four key domains:

1 Physiological Rationale

Many concerns relate to general and neuraxial techniques[3]:
- **Airway instrumentation risks**
- **Cardiorespiratory changes**
- **Altered intrathecal drug spread**
- **Lowered tolerance to sympathetic blockade**

→ rationale for peripheral RA

2 Procedural Feasibility

Bovine-muscle models in simulated microgravity proof-of-concept study
Underwater, free-floating vs normal gravity

Block time: 35s vs 27s
Intraneural injection rate : 5% vs 5%
Success rate: 85% vs 80%
Image/needle placement ease: Similar

3 Pharmaceutical Stability

ISS Data (Lidocaine & Epinephrine)
- Lidocaine Potency: <5% deviation from controls, preserved.
- Epinephrine Potency: 10% lower than controls, significant degradation.

Local anesthetic systemic toxicity (LAST) remains a concern due to limited lipid emulsion shelf life[4].

4 Clinical Applications & Limitations

Potential Uses	Limitations
Limb surgery	Ventilatory support
Analgesia for trauma	Major abdominal/ thoracic procedures
Superficial procedures	Infection risk from catheter infusions



Proposed blocks
- Axillary brachial plexus block
- Intrapleural block
- Femoral block
- Sciatic block

DISCUSSION

Evidence base - largely derived from expert opinion.
No reported use of RA in microgravity.
Many physiological concerns are specific to general and neuraxial techniques[2].

Where it's limited
Ventilatory support and intubation requiring procedures, abdominal or thoracic surgery.

Future Research
- Characterise ultrasound imaging and anesthetic spread in higher-fidelity microgravity analogs.
- Assess whether RA skills persist over prolonged missions. It has been successfully taught to, and performed by non-physicians[5].
- Develop protocols for delivery in resource-limited spaceflight environments.

KEY TAKEAWAYS

- RA has potential in spaceflight, particularly in limb injury.
- Evidence is limited and largely theoretical.
- Lidocaine appears stable post-spaceflight, with concerns for epinephrine and LAST.

- Further research is needed on technique, training persistence, pharmacology and delivery.

REFERENCES

1.Houtchens BA. Medical-care systems for long-duration space missions. *Clin Chem*. 1993; 39 (1): 13-21. doi: 10.1093/clinchem/39.1.13
2. Komorowski M, Watkins SD, Lebuffe G, Clark JB. Potential anesthesia protocols for space exploration missions. *Aviat Space Environ Med*. 2013; 84 (3): 226-233. doi: 10.3357/asem.3427.2013
3. Nowadly C, Lovett D, Brawley H, et al. Limited Degradation of Active Pharmaceutical Ingredient After Spaceflight on the International Space Station. *Wilderness & Environmental Medicine*. 2026; 0(0). doi:10.1177/10806032261466966s
4. Scarpa J, Wu CL. The role for regional anesthesia in medical emergencies during deep space flight. *Reg Anesth Pain Med*. 2021; 46 (10): 919-922. doi:10.1136/rapm-2021-102710
5. Newton M, Bird P. Impact of Parallel Anesthesia and Surgical Provider Training in Sub-Saharan Africa: A Model for a Resource-poor Setting. *World J Surg*. 2010; 34: 445-452. doi: 10.1007/s00268-009-0195-z