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Brief Report

Into Thin Air: Extreme Ultrasound on Mt Everest

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Objective

Mountaineers face a variety of health risks at altitude including pulmonary edema; portable ultrasound may be used to diagnose high altitude pulmonary edema. This report tests the functionality of electronic equipment in a hypobaric test environment and the ability of remotely guided nonexperts to use ultrasound to evaluate respiratory status on Mt Everest.

Methods

Two ultrasound devices and associated video equipment were tested in a cooled (4°C–5°C) hypobaric chamber to 27 000 feet (8230 m) before travel to Mt Everest. The ultrasound system was connected via satellite phone to a video streaming device and portable computer to stream video through the Internet for remote guidance of a novice user by an expert. Pulmonary interstitial fluid was quantified by the presence of “comet tail” artifacts.

Results

There was no notable degradation in equipment performance in cold, hypobaric conditions; ultrasound confirmation of increased comet tails was noted in the chamber despite oxygen supplementation and the very brief exposure. Two pulmonary surveys of asymptomatic participants were completed by novice operators within 25 minutes on Mt Everest. The remote expert was able to guide and identify comet tails suggestive of intermediate pulmonary interstitial fluid. Image quality was excellent.

Conclusions

The tested ultrasound devices functioned nominally in cold, hypobaric conditions; acute changes in lung fluid content were noted in these conditions despite normoxia. We successfully used a satellite telemedical connection with a remote expert to guide thoracic ultrasound examinations at Advanced Base Camp on Mt Everest. Coupling portable ultrasound with remote expert guidance telemedicine provides a robust diagnostic capability in austere locations.



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Key words

altitude sickness; pulmonary edema; ultrasound; comet tail

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