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Augmented Reality Integration for Surgical Enhancement in Hepatic Surgery – Review of the Current Literature

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Abstract
Background: Intrahepatic anatomy remains a challenge in mini-invasive liver surgery. Augmented Reality (AR), which integrates digital information with the user's environment, can benefit liver surgery by improving tumor and vessel positioning, resection planning, and surgical training. This review highlights AR's applications in liver surgery.
Methods: Articles published from 2010-2024 on PubMed using keywords (“Augmented Reality” AND “Liver Surgery”) OR (“Navigation” AND “Liver Surgery”) were analyzed. 32 articles assessing AR's accuracy, safety, operative time, and training impact were included.
Results: AR in Image-Guided Surgery (IGS) combines 3D reconstructions (e.g., CT scans) with laparoscopic images, enhancing the understanding of the surgical site. AR aids in margin planning, lesion boundary setting, and accurate hemostasis. It improves oncological outcomes, reduces errors, increases accuracy, and sometimes shortens surgery time. AR also enhances surgical training by accelerating skill acquisition and reducing the learning curve. However, more data is needed to standardize AR techniques.
Conclusion: AR can significantly enhance mini-invasive liver surgery by improving precision, safety, efficiency, and training. While further research is necessary to standardize techniques, AR holds great potential for improving surgical outcomes and training quality.
Keywords: augmented reality, hepatic surgery, surgical navigation, intraoperative imaging