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AUTOMATED BILIARY SEGMENTATION FOR PERCUTANEOUS TRANSHEPATIC BILIARY DRAINAGE: A COMPARATIVE STUDY OF NEURAL NETWORK MODELS

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Abstract:
***Purpose:** Patients with pathological obstructive jaundice are often ineligible for concurrent chemotherapy due to elevated bilirubin levels. Percutaneous transhepatic biliary drainage (PTBD) is commonly performed to lower bilirubin values to restart chemotherapy or for palliative purposes. However, based on biliary anatomy, there are no clear recommendations on which patients would benefit most from PTBD. A method to quantify the extent of biliary dilatation could help select appropriate patients for this intervention, thereby optimizing the outcomes of PTBD. The purpose of this study was to develop an automated biliary segmentation model for optimizing PTBD and improving patient selection and therapeutic outcomes.
***Methods and Materials:** A single-institution retrospective analysis of patients diagnosed with obstructive jaundice who underwent PTBD from January 2016 to May 2024 was performed. Patients without pre- and post-operative CT scans were excluded from the analysis. A trained interventional radiologist with 5 years of experience performed ground-truth segmentations on 89 cases (MIM 7.1.4, Beechwood, OH). A total of 5 neural network models were then trained and validated on this dataset in a 70:30 train/test split. These models were nnU-net, and 4 versions of a novel model, Medical Imaging Segmentation Toolkit (MIST): MIST-DICE cross-entropy, MIST-clDice-constant, MIST-clDice-linear, and MIST-clDice-cosine. All models were trained with the same parameters. ANOVA was used to compare the average DICE scores of the models.
***Results:** 89 segmentations were used, 56 for training and 33 for validation, with various high and low biliary obstructions. The DICE scores for the Medical Imaging Segmentation Toolkit (MIST) models were as follows: MIST-Constant achieved 0.8313, MIST-Cosine 0.8307, MIST-Linear 0.8206, and MIST-DICE-Cross Entropy 0.8379. In comparison, the nnU-net model obtained a DICE score of 0.6215. There was a significant improvement in the MIST models over the standard nnU-net (p=0.01, **Figure 1**).
***Conclusions:** MIST is a novel automated neural network model that effectively segments dilated biliary ducts in cases of obstructive jaundice.
***Clinical Relevance/Application:** This is the first automated biliary duct segmentation model that specializes in recognizing dilated biliary ducts in various cases of obstructive jaundice. MIST outperforms the current industry standard (nnU-net) in automated segmentation. This automated tool will aid in identifying optimal PTBD placement for obstructive jaundice, potentially answering an unmet clinical need for treatment optimization.

Category (Complete): Multiomic and Multicenter Radiology AI - Clinical integration of multiomic and multicenter radiology AI for diagnosis, risk stratification, and clinical decision-making
Questions (Complete):
Disclosure of "Off-Label" usage: No, I do not intend to discuss off-label uses
IRB / IACUC Response: Human subject, and received IRB approval
Has this work been previously presented or published?: No
I verify : True

Attached Files: Bar graph of performance and automated segmentation example. (PDF, 170327 bytes)

Status: Complete

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