

# Combination of deep learning and ensemble machine learning using intraoperative video images strongly predicts recovery of urinary continence after robot-assisted radical prostatectomy.

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## Abstract

**Objectives:** We recently reported that deep learning (DL) using pelvic magnetic resonance imaging is useful for predicting the severity of urinary incontinence (UI) after robot-assisted radical prostatectomy (RARP). However, our results were limited because the prediction accuracy was approximately 70%. We aimed to develop a more accurate prediction system that can be used to inform patients on recovery from UI after RARP using a DL model based on intraoperative video images. **Materials and Methods:** This study included 101 patients with prostate cancer who underwent RARP. Three snapshots showing the pelvic cavity (before bladder neck incision, just after prostate removal, and after vesicourethral anastomosis) from intraoperative video records, as well as preoperative and intraoperative covariates, were assessed. We evaluated the DL models plus simple or ensemble machine learning, and their sensitivity, specificity, and area under the receiver operating characteristic curve (AUC) were analyzed. **Results:** Sixty-four and 37 patients demonstrated ‘early continence’ and ‘late continence’, respectively, at the 3-month follow-up. The combination of DL and simple machine learning using intraoperative video snapshots with clinicopathological parameters had a notably high performance (AUC, 0.683 to 0.749) for predicting early recovery from post-prostatectomy UI. Notably, the combination of DL and ensemble artificial neural network using intraoperative video snapshots had the highest performance (AUC, 0.882; sensitivity, 92.2%; specificity, 78.4%; overall accuracy, 85.3%) for predicting early recovery from post-prostatectomy UI. In contrast, DL and ensemble ML with clinicopathological parameters (Method 4) achieved no additive effects (AUC, 0.690 to 0.747) compared with DL and simple ML with clinicopathological parameters. Internal validation was performed on additional 30 cases with similar results. **Conclusions:** Our results suggest that DL algorithms using intraoperative video images can be used to reliably inform patients regarding their recovery from UI after RARP. (287 words)

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