ISC 2019 第七届互联网安全大会

人工治能-人工智能下的肿瘤放疗和数据安全

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人工“治”能
——人工智能下的肿瘤放疗和数据安全
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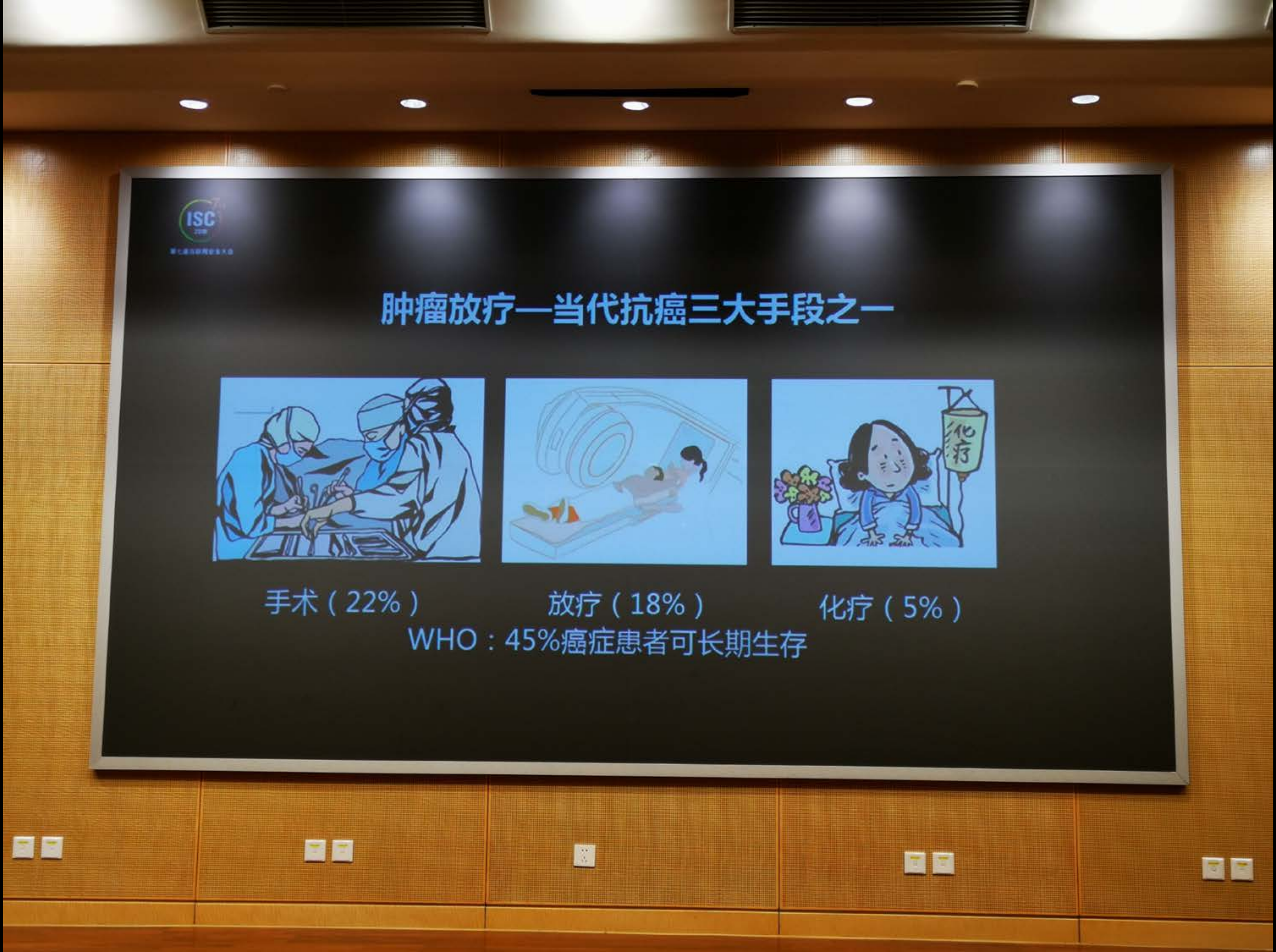
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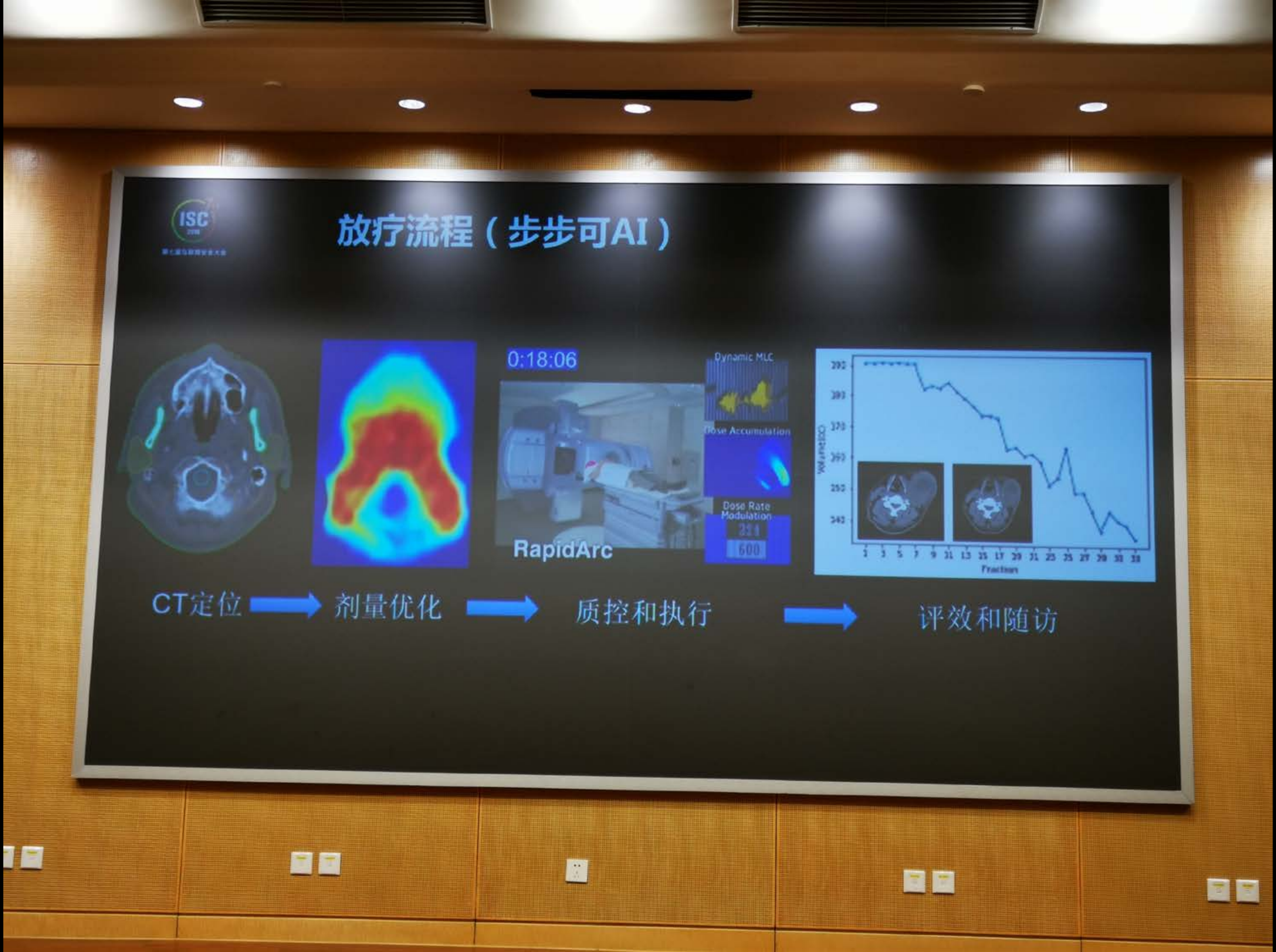
肿瘤放疗—当代抗癌三大手段之一
化疗
手术（22%）
放疗（18%）
化疗（5%）
WHO：45%癌症患者可长期生存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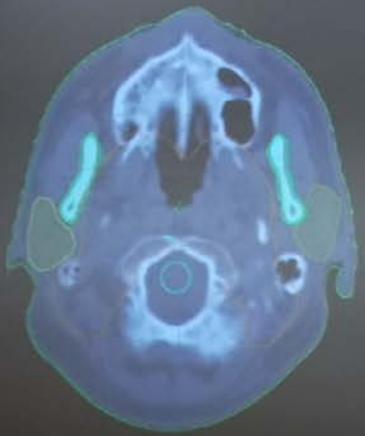
放疗流程（步步可AI）
0:18:06
Dynamic MLC
Dose Accumulation
Dose Rate Modulation
RapidArc
Fraction
CT定位
剂量优化
质控和执行
评效和随访

CT定位环节的AI



提高图像质量

Higaki T, Nakamura Y, Tatsugami F, et al. Improvement of image quality at CT and MRI using deep learning[J]. Japanese Journal of Radiology, 2018, 37(2):73-80.

降低成像剂量

S Setlur Nagesh, D Bednarek, S Rudin*, Convolution Neural Network Based X-Ray Dose Reduction Technique for Fluoroscopy and Angiography. Medical Physics, 46 (6), June 2019 e212

图像配准和器官分割

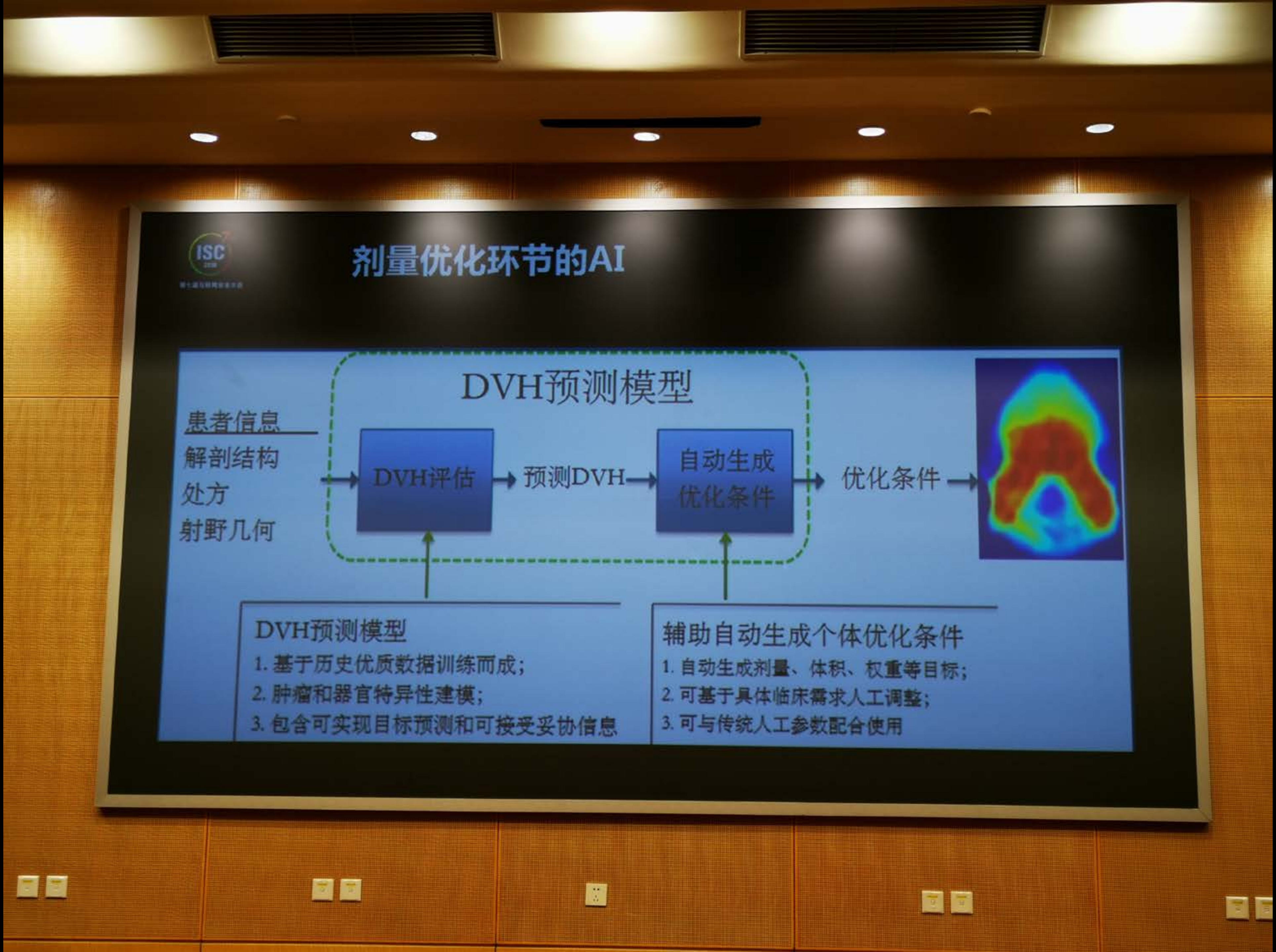
Huang, H. L. A review of segmentation and deformable registration methods applied to adaptive cervical cancer radiation therapy treatment planning[J]. Artificial Intelligence in Medicine, 2015, 64(2):75-87.

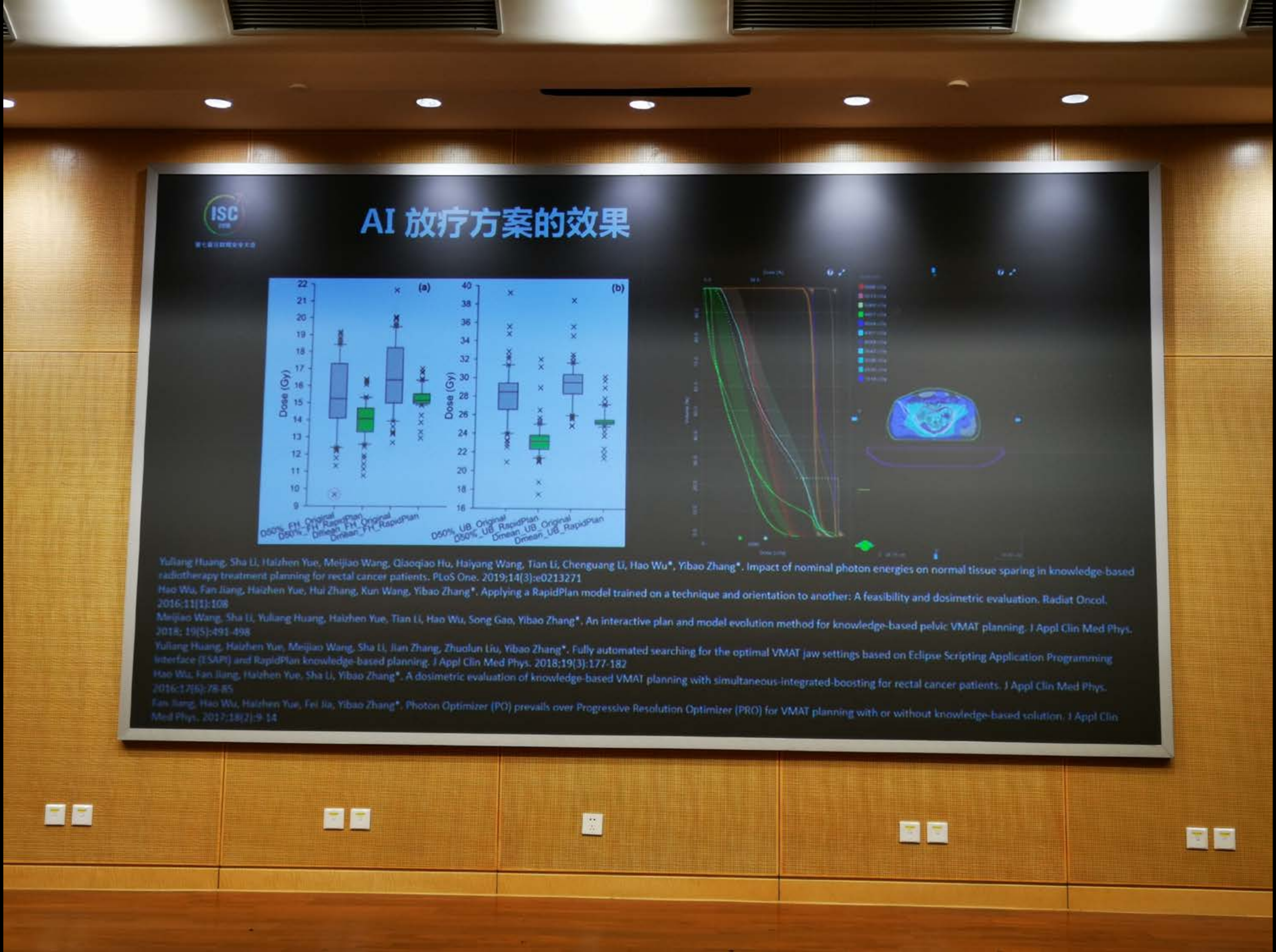
基于MR的合成CT

Kazemifar S, Mcguire S, Timmerman R, et al. MRI-only brain radiotherapy: assessing the dosimetric accuracy of synthetic CT images generated using a deep learning approach[J]. Radiotherapy and Oncology, 2019, 136:56-63.

肿瘤靶区智能勾画&辅助诊断

Men K, Chen X, Zhang Y, et al. Deep Deconvolutional Neural Network for Target Segmentation of Nasopharyngeal Cancer in Planning Computed Tomography Images [J]. Frontiers in Oncology, 2017, 7:315.


ISC
剂量优化环节的AI
DVH预测模型
患者信息
解剖结构
处方
射野几何
DVH评估
预测DVH
自动生成
优化条件
优化条件
DVH预测模型
1. 基于历史优质数据训练而成；
2. 肿瘤和器官特异性建模；
3. 包含可实现目标预测和可接受妥协信息
辅助自动生成个体优化条件
1. 自动生成剂量、体积、权重等目标；
2. 可基于具体临床需求人工调整；
3. 可与传统人工参数配合使用



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AI 放疗方案的效果
(a)
Dose (Gy)
D50%_FH_Original
D50%_FH_RapidPlan
Dmean_FH_Original
Dmean_FH_RapidPlan
(b)
Dose (Gy)
D50%_UB_Original
D50%_UB_RapidPlan
Dmean_UB_Original
Dmean_UB_RapidPlan
Yuliang Huang, Sha Li, Haizhen Yue, Meijiao Wang, Qiaoqiao Hu, Haiyang Wang, Tian Li, Chenguang Li, Hao Wu*, Yibao Zhang*. Impact of nominal photon energies on normal tissue sparing in knowledge-based radiotherapy treatment planning for rectal cancer patients. PLoS One. 2019;14(3):e0213271
Hao Wu, Fan Jiang, Haizhen Yue, Hui Zhang, Kun Wang, Yibao Zhang*. Applying a RapidPlan model trained on a technique and orientation to another: A feasibility and dosimetric evaluation. Radiat Oncol. 2016;11(1):108
Meijiao Wang, Sha Li, Yuliang Huang, Haizhen Yue, Tian Li, Hao Wu, Song Gao, Yibao Zhang*. An interactive plan and model evolution method for knowledge-based pelvic VMAT planning. J Appl Clin Med Phys. 2018; 19(5):491-498
Yuliang Huang, Haizhen Yue, Meijiao Wang, Sha Li, Jian Zhang, Zhuolun Liu, Yibao Zhang*. Fully automated searching for the optimal VMAT jaw settings based on Eclipse Scripting Application Programming Interface (ESAPI) and RapidPlan knowledge-based planning. J Appl Clin Med Phys. 2018;19(3):177-182
Hao Wu, Fan Jiang, Haizhen Yue, Sha Li, Yibao Zhang*. A dosimetric evaluation of knowledge-based VMAT planning with simultaneous-integrated-boosting for rectal cancer patients. J Appl Clin Med Phys. 2016;17(6):78-85
Fan Jiang, Hao Wu, Haizhen Yue, Fei Jia, Yibao Zhang*. Photon Optimizer (PO) prevails over Progressive Resolution Optimizer (PRO) for VMAT planning with or without knowledge-based solution. J Appl Clin Med Phys. 2017;18(2):9-14

质控和执行环节的AI

体表光学成像引导的摆位

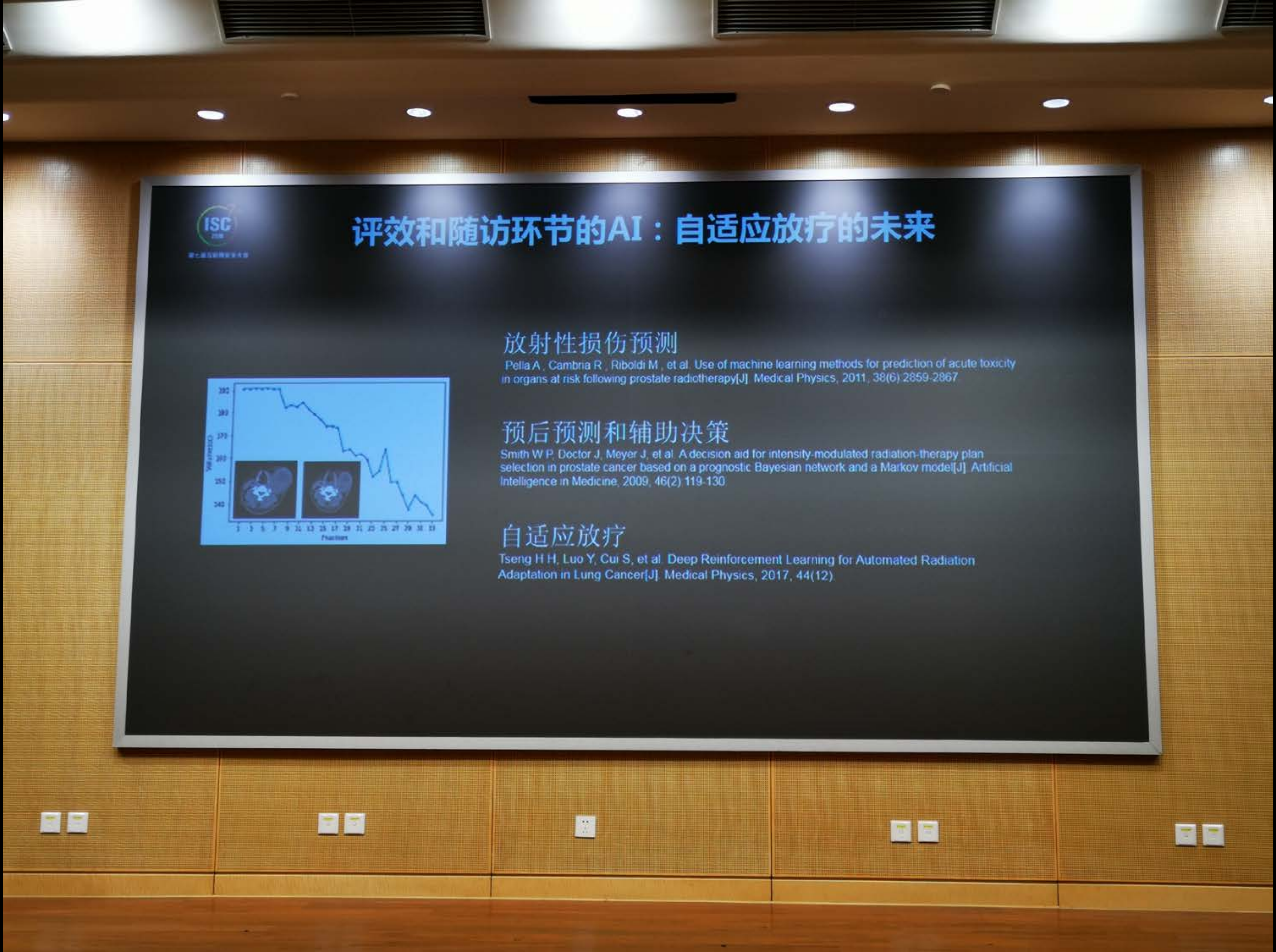
J Wang*, Y Yuan, W Hu, Z Zhang. Using Deep Learning for Patient Surface Registration in Rectal Cancer Radiotherapy: A Feasibility Study. Medical Physics, 46 (6), June 2019 e166

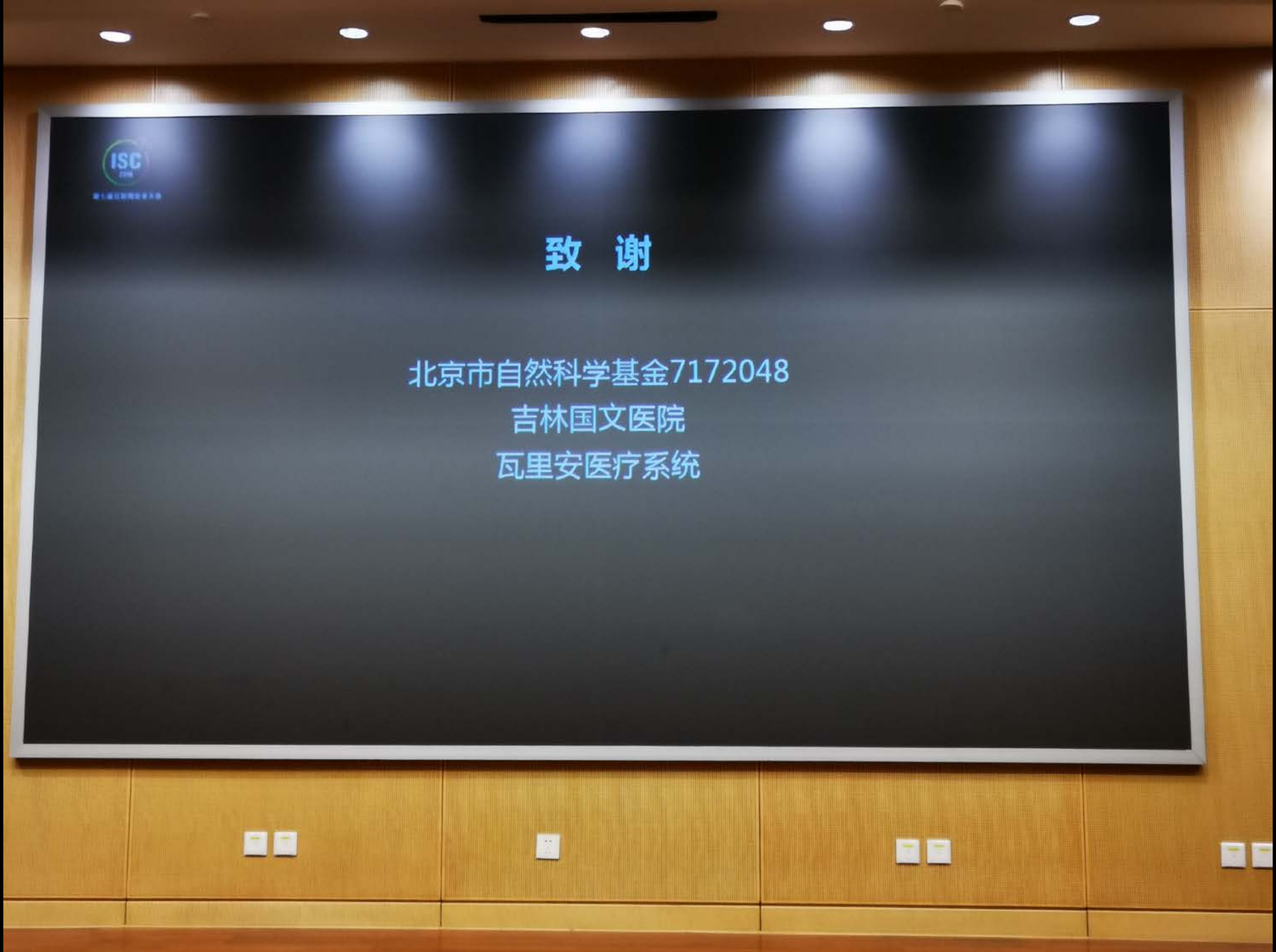
治疗过程中的器官运动管理

Lee S K, Kim Y N, Park K R, et al. Prediction of Target Motion Using Neural Network for 4-dimensional Radiation Therapy[J]. 2009

执行过程错误识别和误差分析

Nyflot M J, Thammasorn P, Wootton L S, et al. Deep learning for patient-specific quality assurance: identifying errors in radiotherapy delivery by radiomic analysis of gamma images with convolutional neural networks[J]. Medical Physics, 2018


ISC
评效和随访环节的AI：自适应放疗的未来
放射性损伤预测
Pella A , Cambria R , Riboldi M , et al. Use of machine learning methods for prediction of acute toxicity in organs at risk following prostate radiotherapy[J]. Medical Physics, 2011, 38(6):2859-2867
预后预测和辅助决策
Smith W P, Doctor J, Meyer J, et al. A decision aid for intensity-modulated radiation-therapy plan selection in prostate cancer based on a prognostic Bayesian network and a Markov model[J]. Artificial Intelligence in Medicine, 2009, 46(2):119-130
自适应放疗
Tseng H H, Luo Y, Cui S, et al. Deep Reinforcement Learning for Automated Radiation Adaptation in Lung Cancer[J]. Medical Physics, 2017, 44(12).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致 谢
北京市自然科学基金7172048
吉林国文医院
瓦里安医疗系统

小鹅助理

谢谢！

扫码添加小鹅助理，与数万科技圈人士

分享重量级活动PPT、干货培训课程、高端会议免费门票