Artificial Intelligence Prediction of Cholecystectomy Operative Course from Automated Identification of Gallbladder Inflammation

SAGES Annual Meeting

Thomas Ward, MD
Surgical Artificial Intelligence and Innovation Laboratory
Massachusetts General Hospital

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Disclosures

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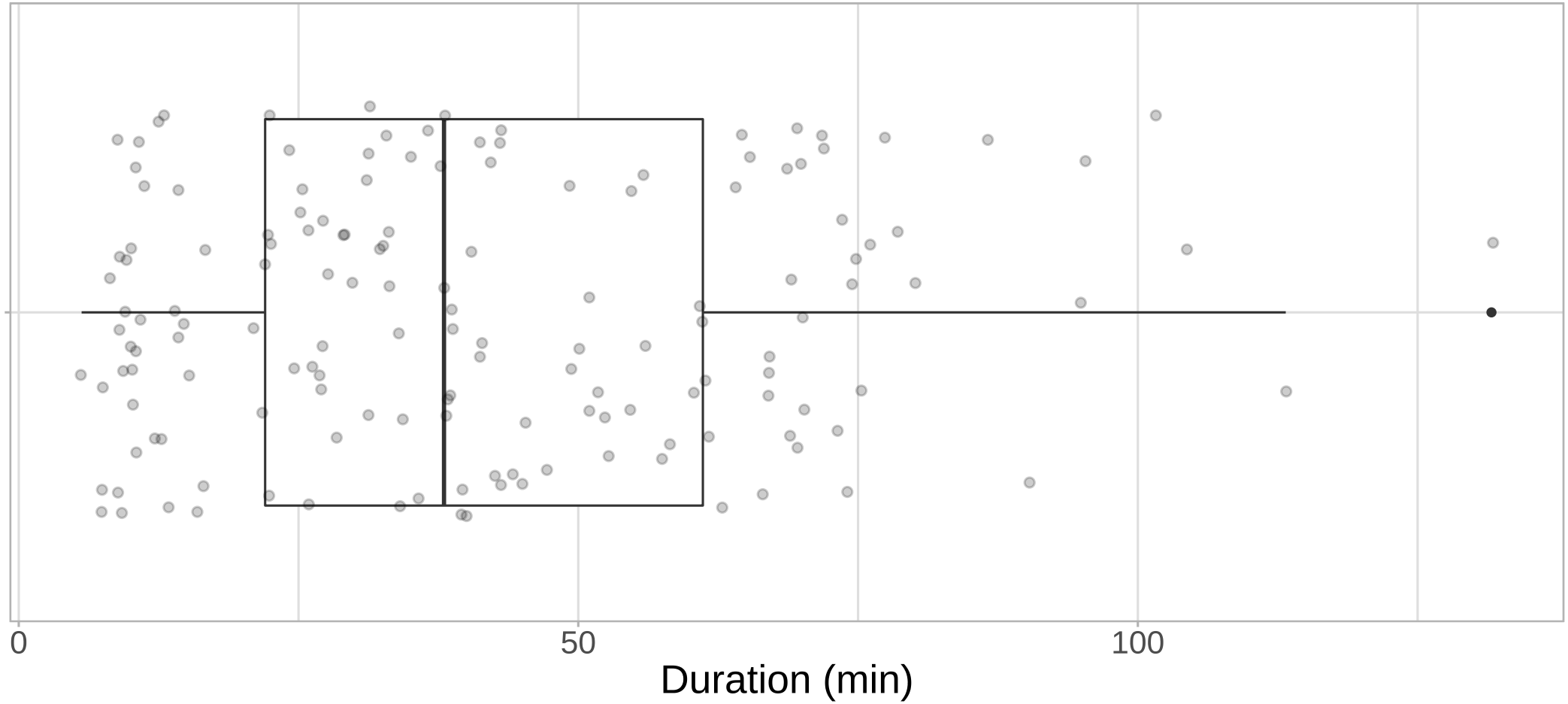
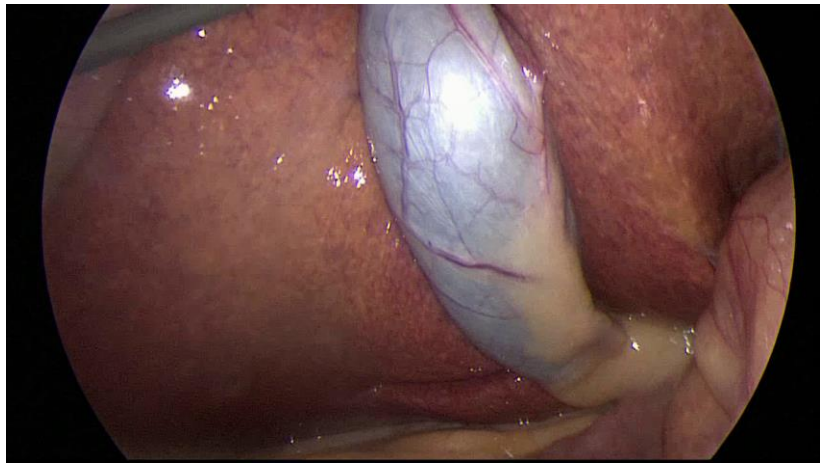
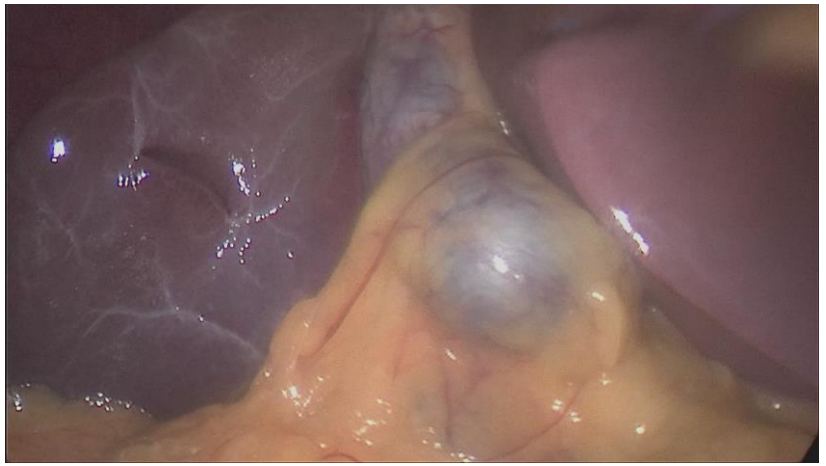
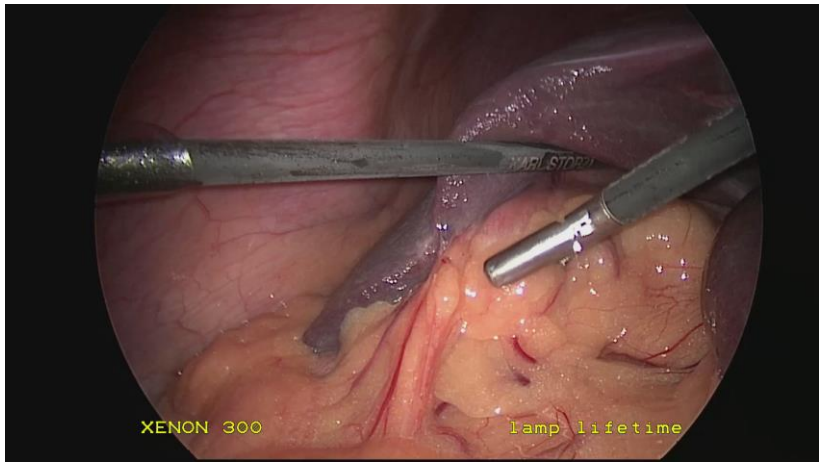
Operative Courses of Cholecystectomy

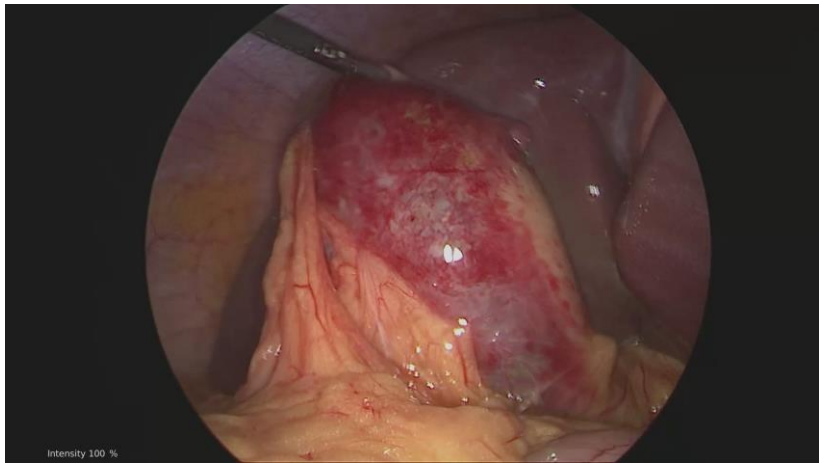


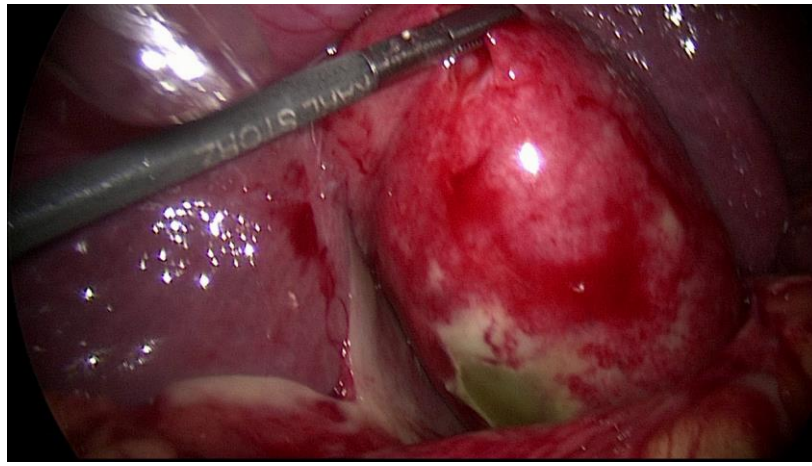
Parkland Grading Scale (PGS)



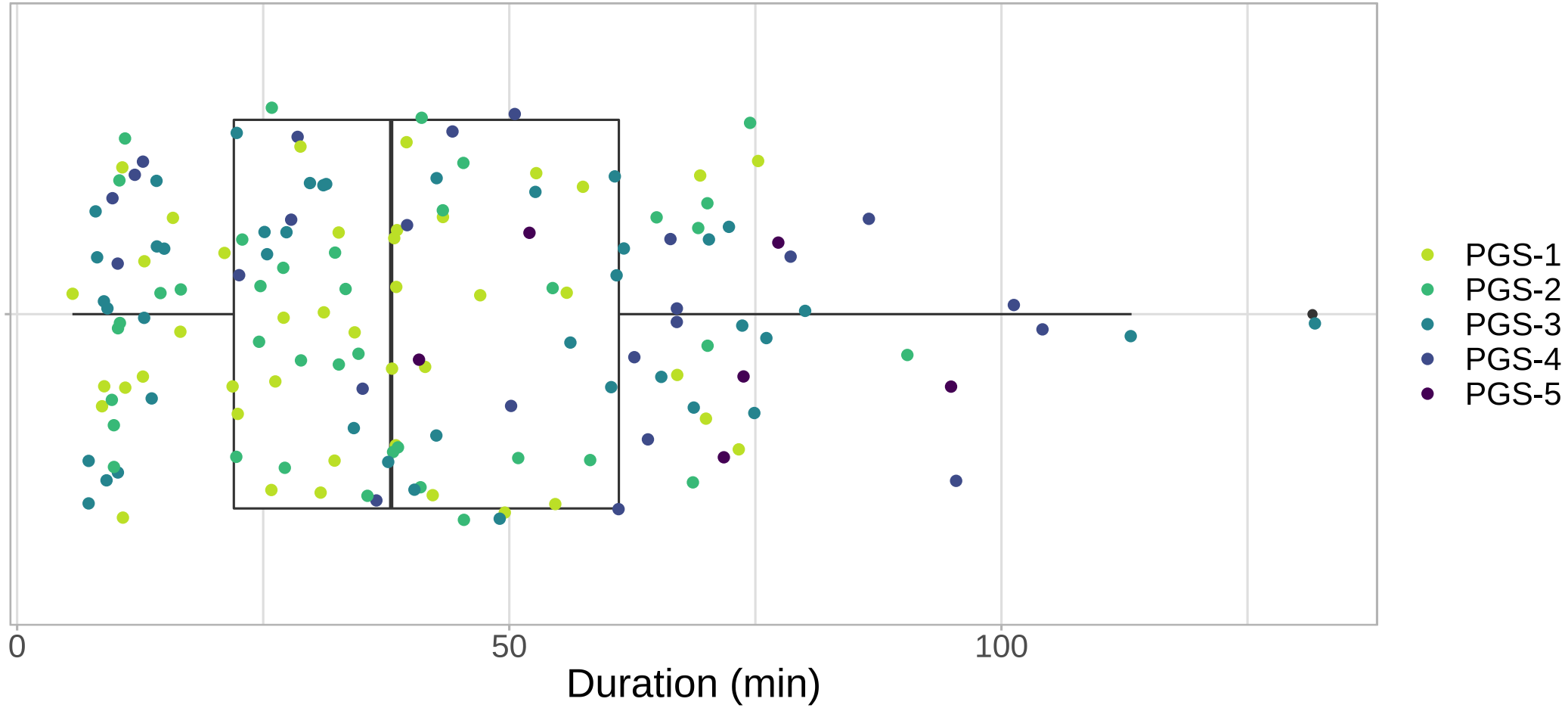




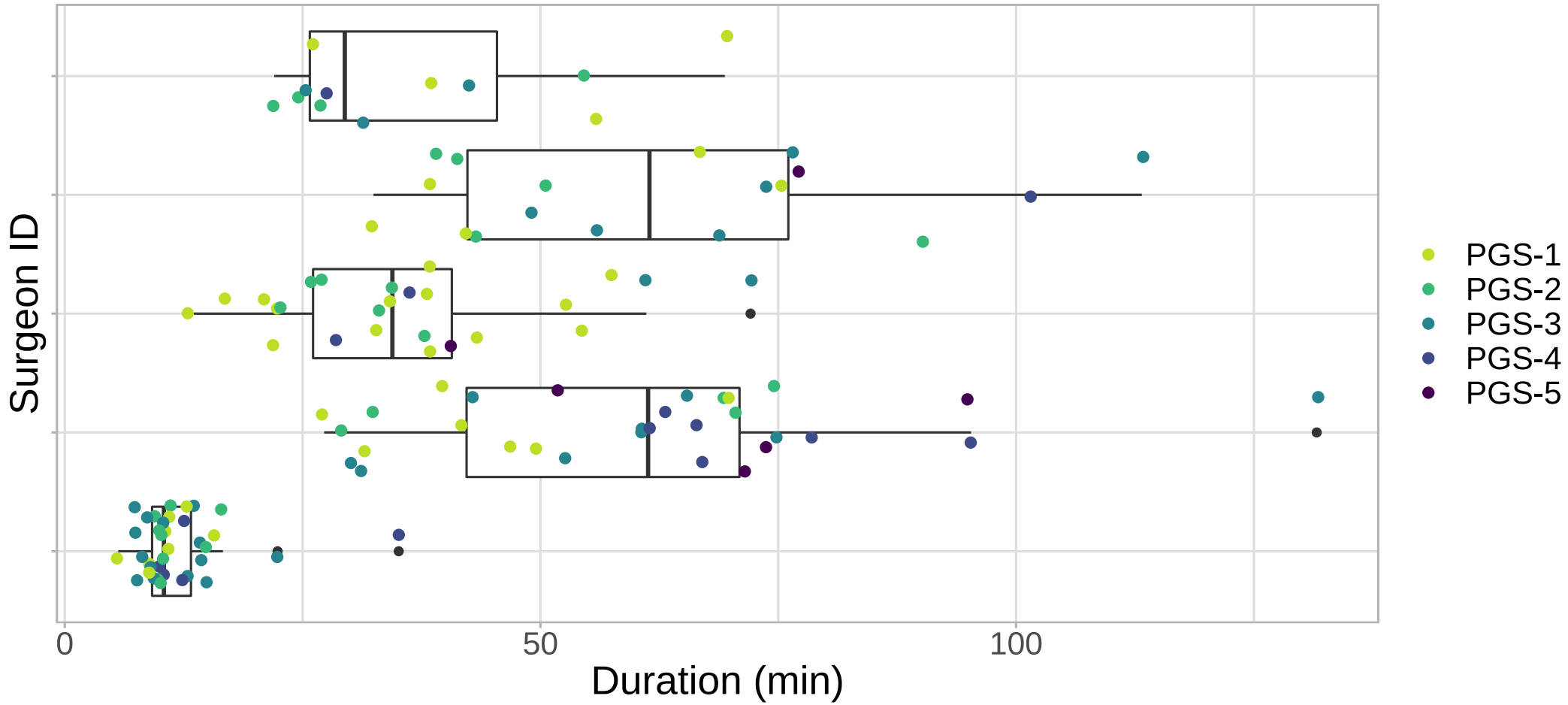




Operative Courses of Cholecystectomy



Surgeon and PGS



Bayesian Inference using Hamiltonian Monte Carlo Sampling

$$\log(Duration_i) \sim \text{Normal}(\mu_i, \sigma)$$

$$\mu_i = \alpha_{sid[i]} + \beta_{sid[i]} * \sum_{j=0}^{PGS_i - 1} \delta_j$$

$$\begin{bmatrix} \alpha_{sid} \\ \beta_{sid} \end{bmatrix} \sim \text{MVNormal}\left(\begin{bmatrix} \alpha \\ \beta \end{bmatrix}, \mathbf{S}\right)$$

$$\alpha \sim \text{Normal}(0,1)$$

$$\beta \sim \text{Normal}(0,1.2)$$

$$\delta \sim \text{Dirichlet}(2)$$

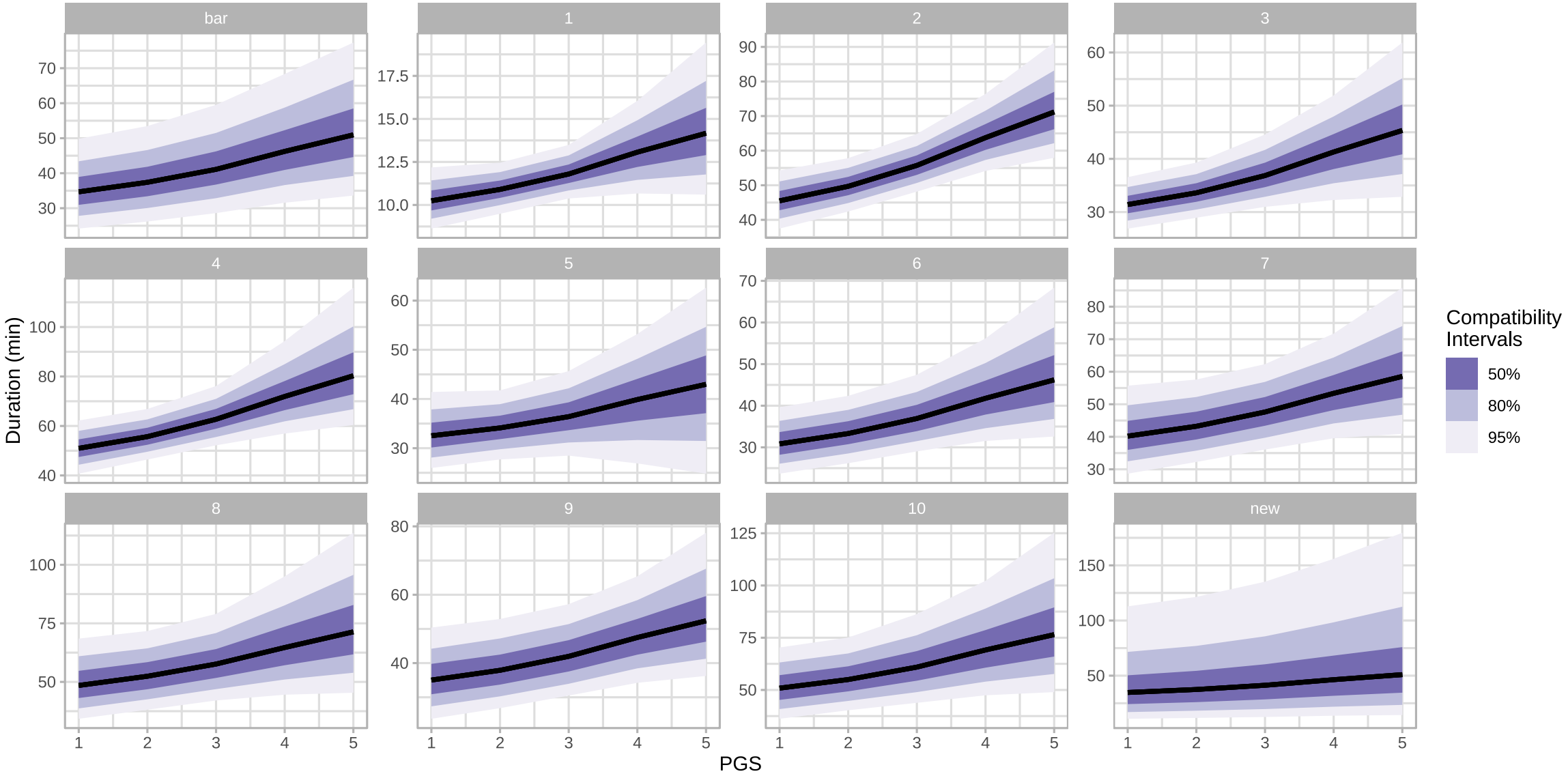
$$\mathbf{S} = \begin{pmatrix} \sigma_a & 0 \\ 0 & \sigma_\beta \end{pmatrix} \mathbf{R} \begin{pmatrix} \sigma_a & 0 \\ 0 & \sigma_\beta \end{pmatrix}$$

$$\mathbf{R} = \begin{pmatrix} 1 & \rho \\ \rho & 1 \end{pmatrix}$$

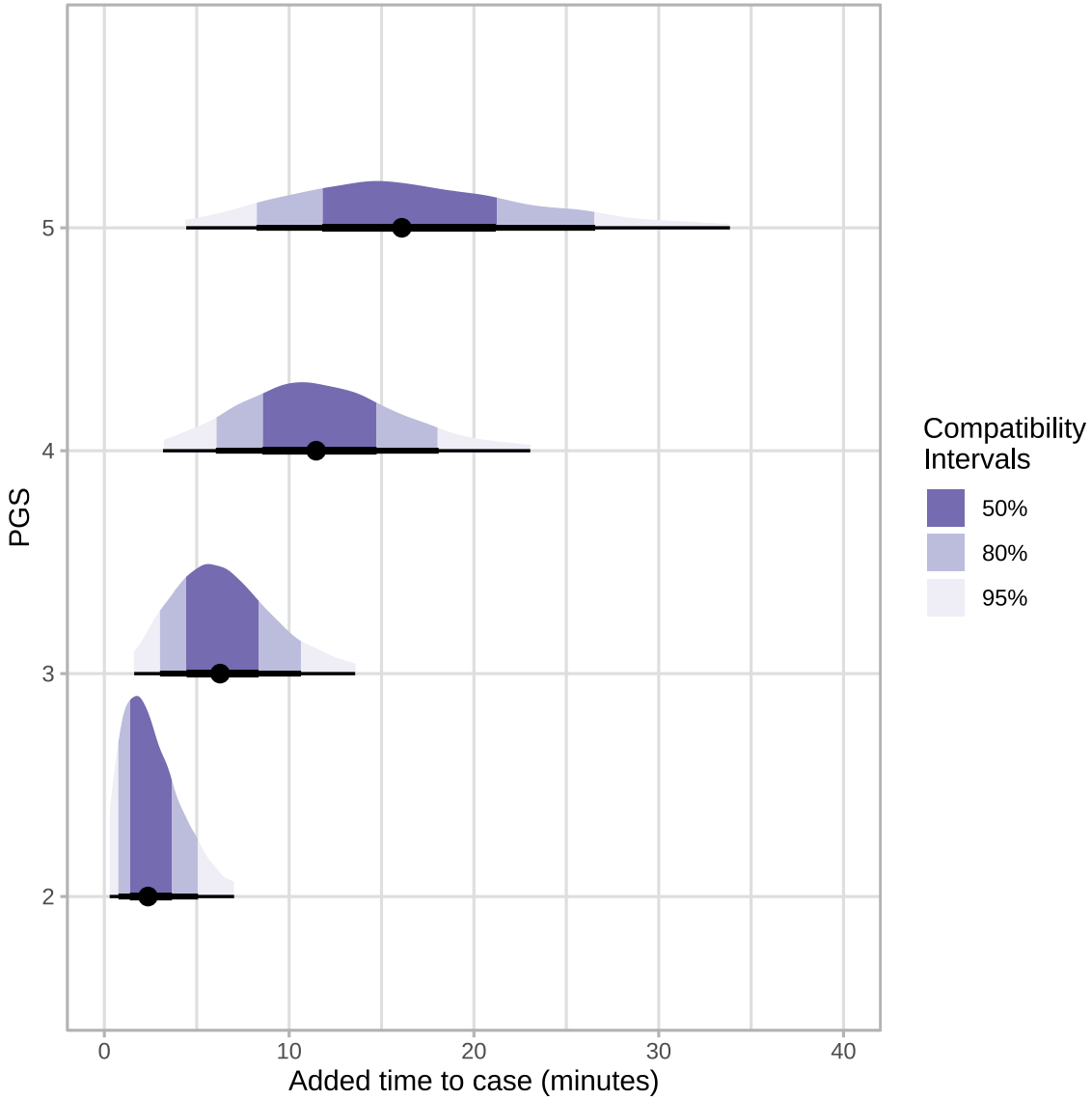
$$\mathbf{R} \sim \text{LKJCorr}(4)$$

$$\sigma, \sigma_\alpha, \sigma_\beta \sim \text{Exponential}(1)$$

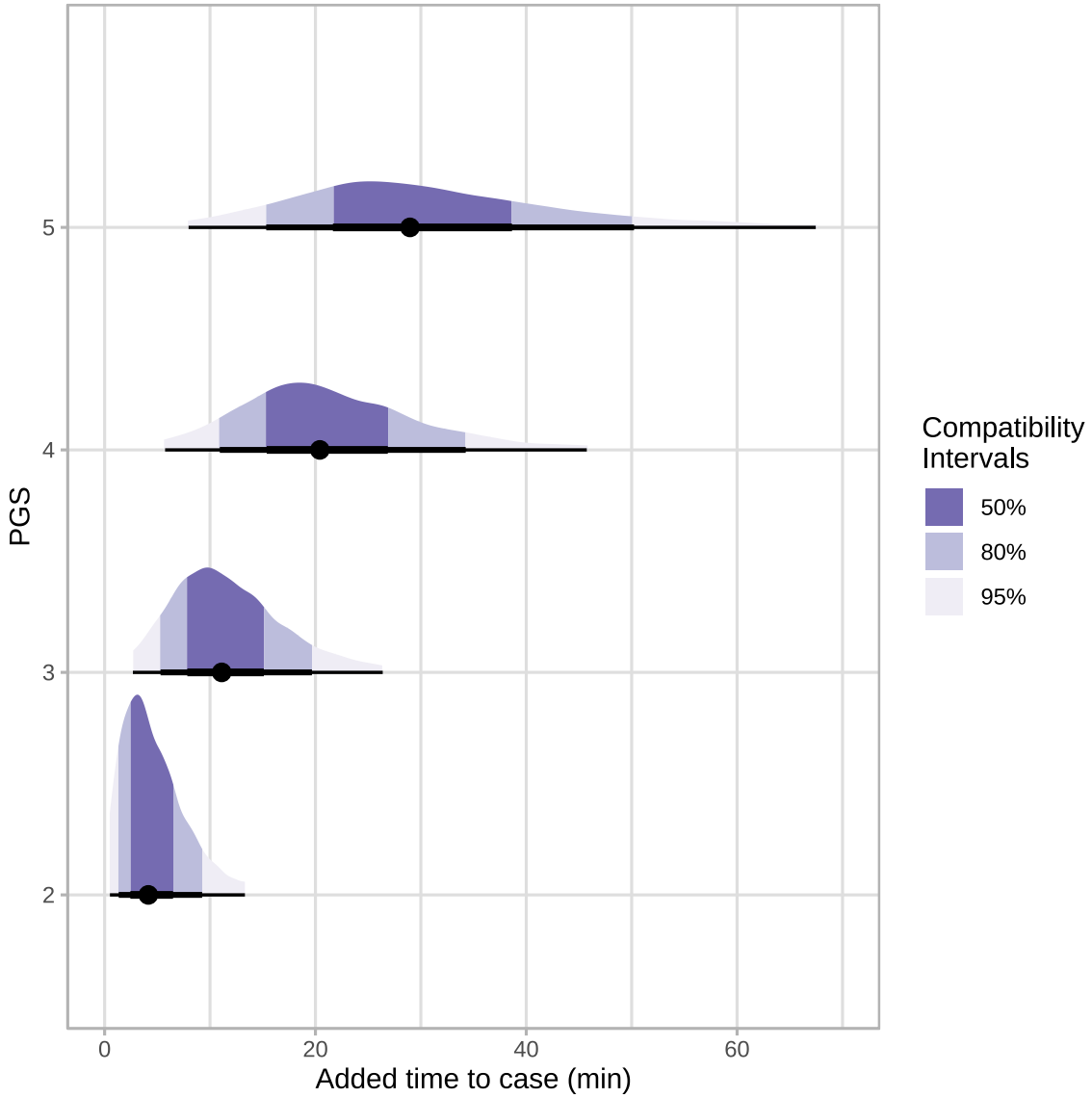
Operative Duration



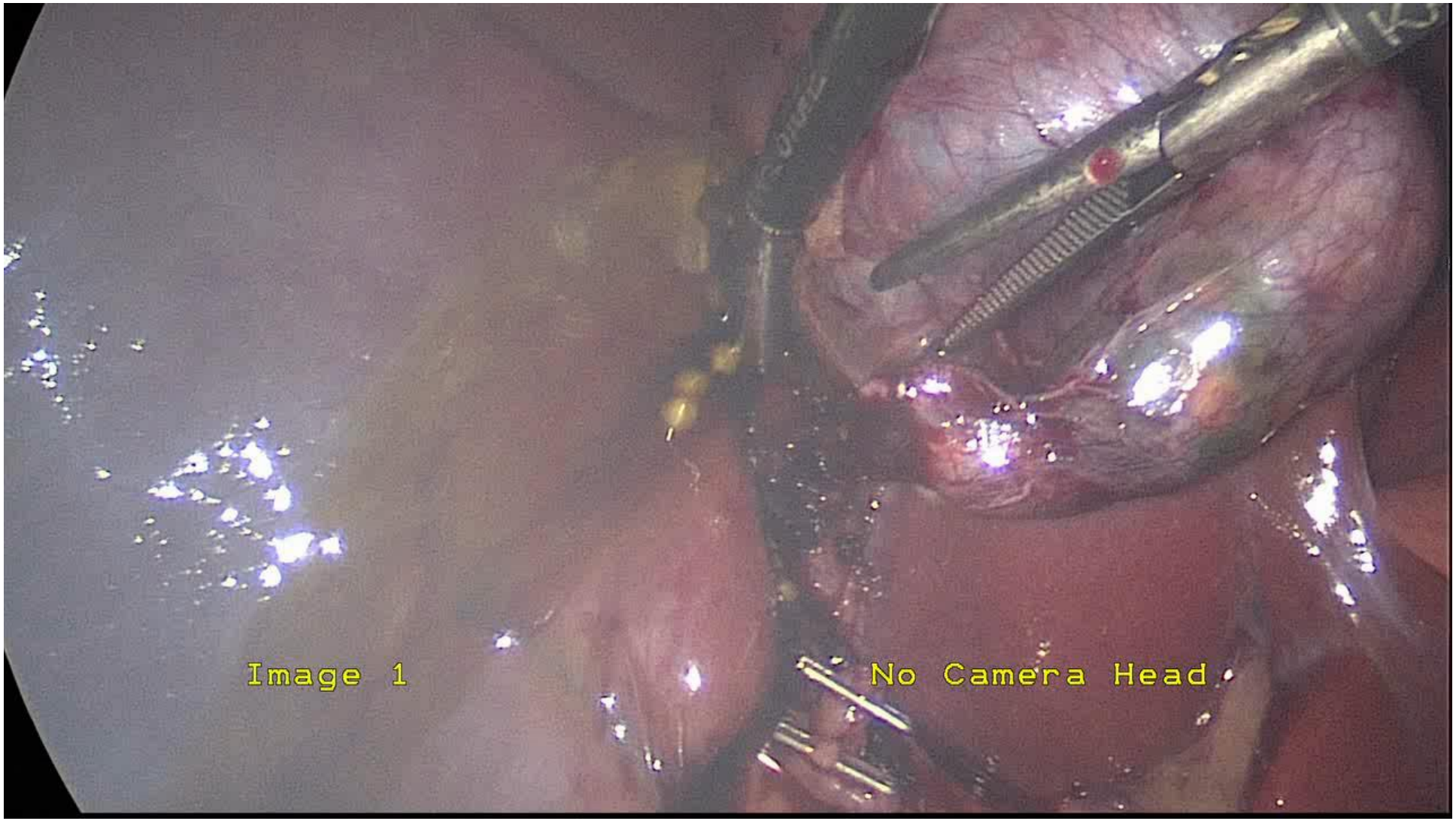
Average



Most affected



Inadvertent Gallbladder Hole



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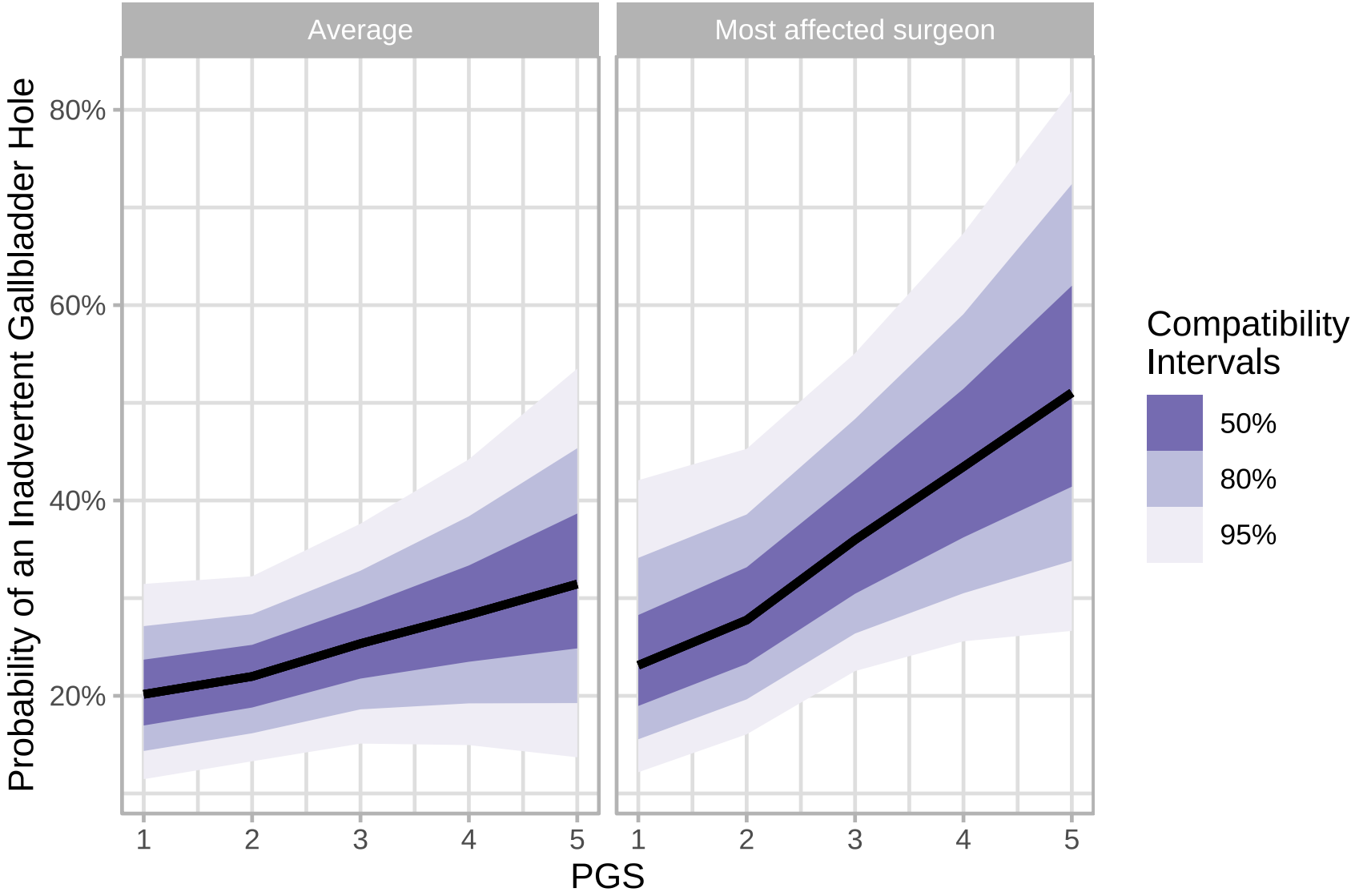
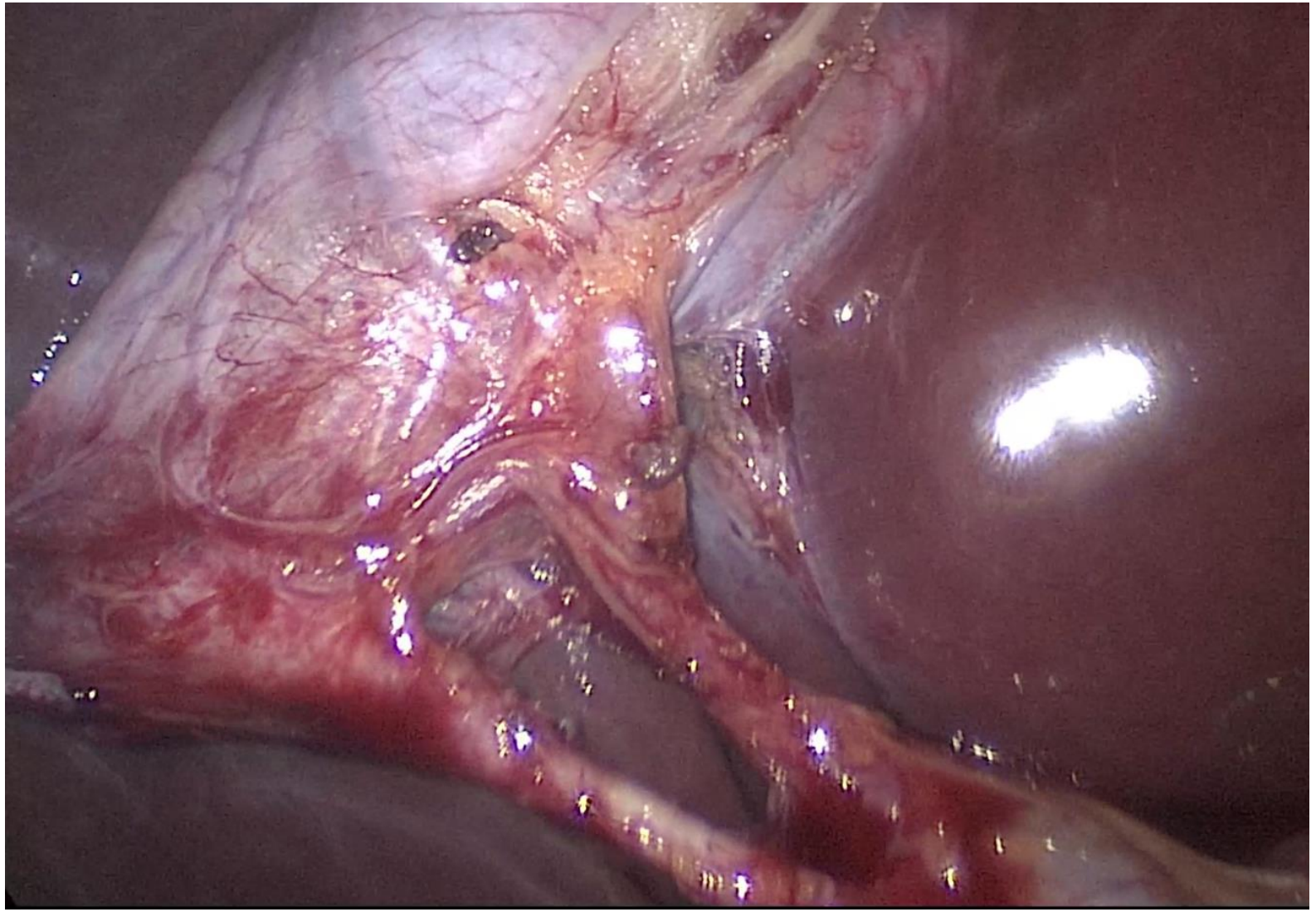
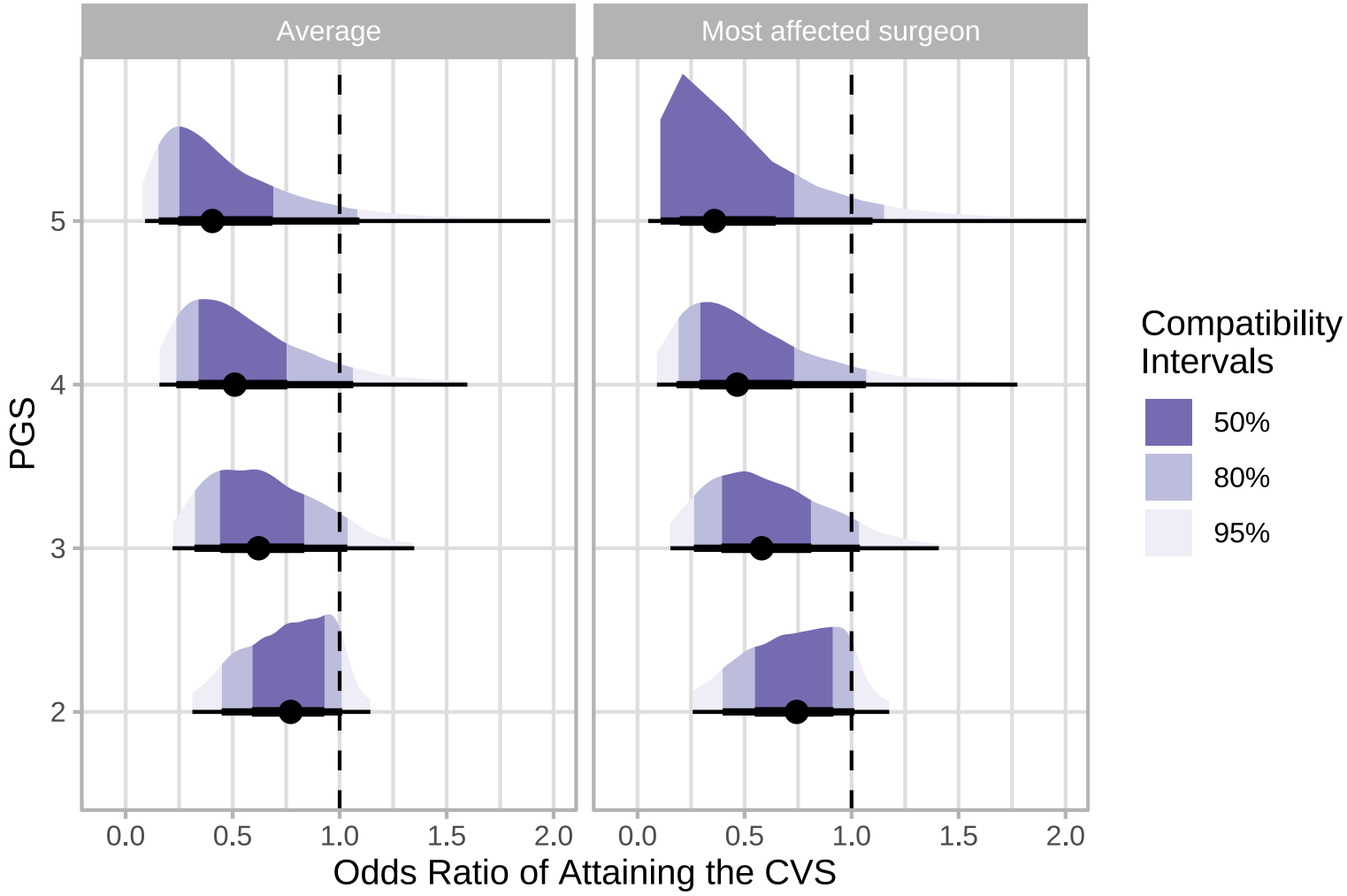


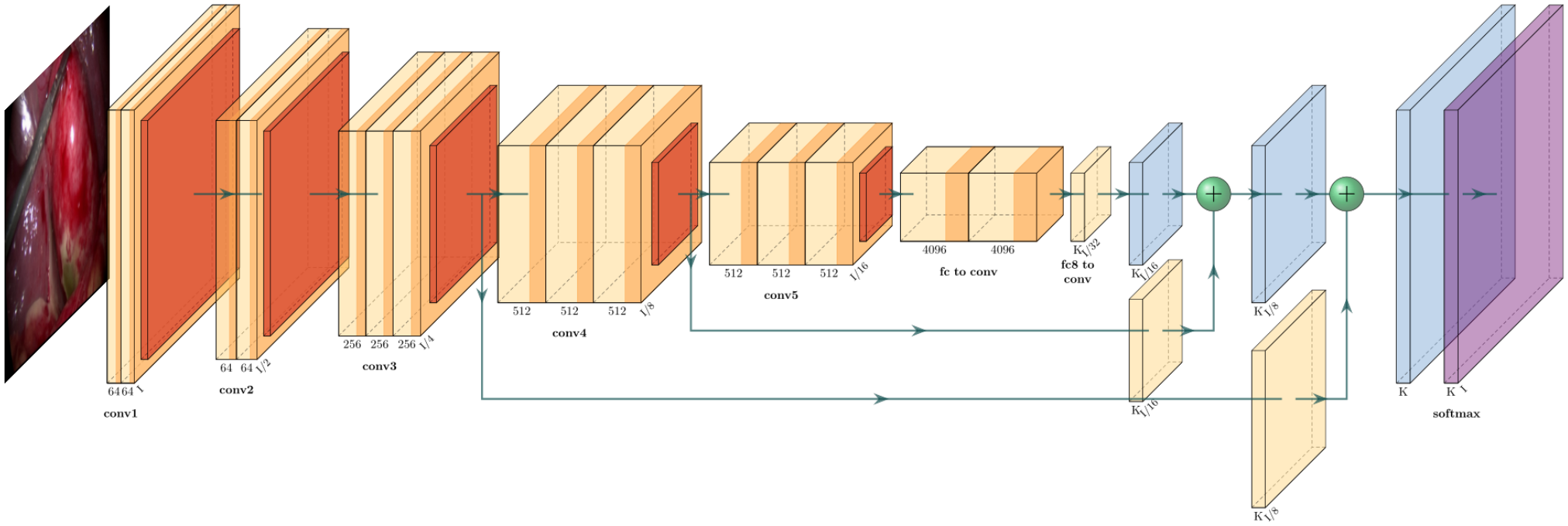
Critical View of Safety



Critical View of Safety



Artificial Intelligence Computer Vision Model



PGS-?

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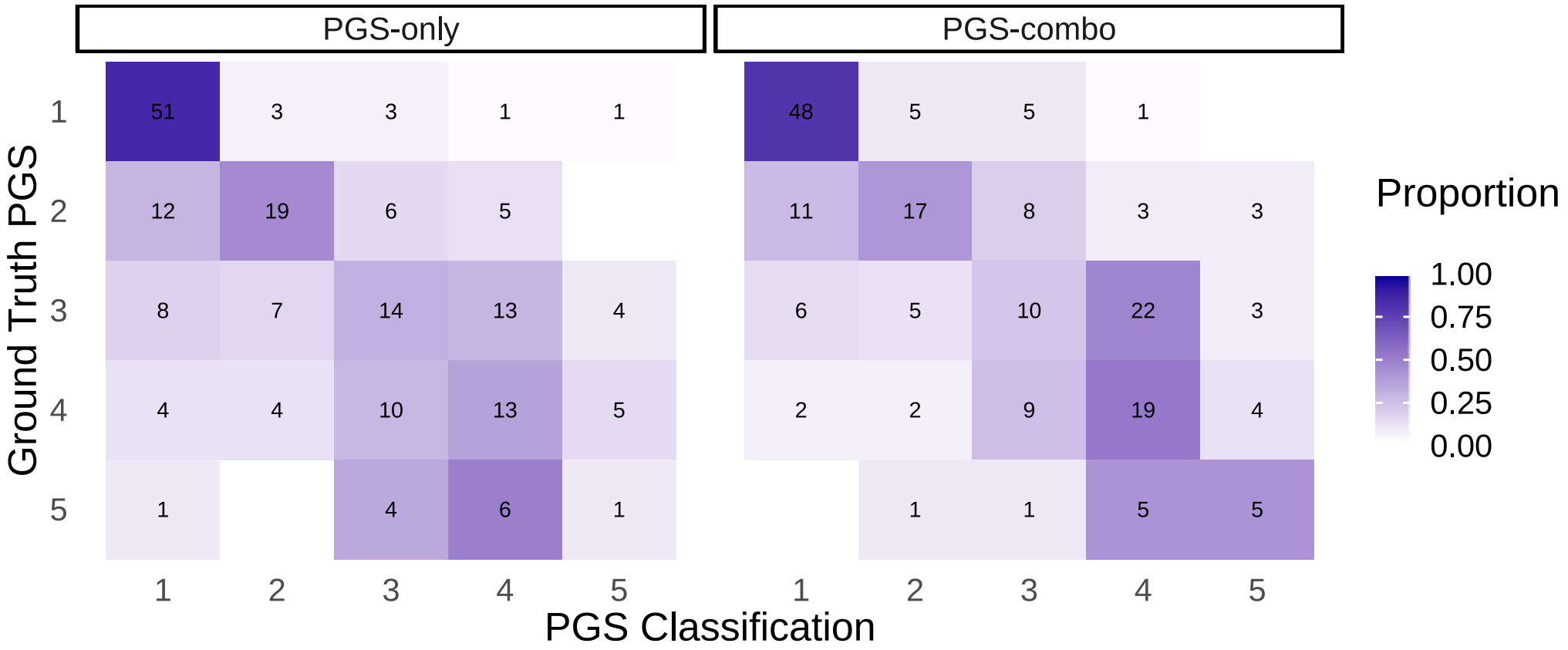

Conclusions

- Gallbladder inflammation is predictive of intra-operative course
- AI computer vision model can reliably identify the degree of gallbladder inflammation
- Applications:
  - Operating room workflow optimization
  - Targeted per-surgeon and per-resident feedback