

Surgical Phase Recognition: From Public Datasets to Real-World Data

Kadir Kirtac^{1,2,*}; Nizamettin Aydin² ; Joël L. Lavanchy³ ; Guido Beldi³ ; Marco Smit¹ ; Michael S. Woods¹ ; Florian Aspart^{1,*}

1 CareSyntax GmbH., Komturstr. 18A, 12099, Berlin, Germany

2 Yildiz Technical University, Computer Engineering Department, 34220, Istanbul, Turkey

3 Department of Visceral Surgery and Medicine, Inselspital, Bern University Hospital, University of Bern, 3010, Bern, Switzerland

* Correspondence: kadir.kirtac@caresyntax.com or kadir.kirtac@std.yildiz.edu.tr (KK); florian.aspart@caresyntax.com (FA)

Supplementary Information

Table S1. Definitions of phases

Phase	Definition
Preparation	Begins as soon as the camera is inserted into the abdomen for the first time and the optical trocar is no longer visible in the image.
Calot Triangle Dissection	Begins as soon as an instrument appears in the image. The phase includes the dissection of connective tissue and fat around the gallbladder and the nearby abdominal cavity to reach the Calot's Triangle.
Gallbladder Drainage	A metal needle is used to puncture the gallbladder before the dissection of Calot's Triangle, to reduce its volume if it is too full to be grasped. This phase ends as soon as another instrument for dissection/coagulation enters the picture is visible.
Clipping	Begins with the appearance of a clipper, which clips the cystic artery or the cystic duct before cutting.
Cutting	Begins with the appearance of a scissors, which cuts the cystic artery or the cystic duct after clipping.
Gallbladder Dissection	Begins after cutting the cystic duct and artery, as soon as the preparation scissors or the electric hook touches the gallbladder.
Gallbladder Packaging	Begins as soon as the specimen bag enters the picture. This phase ends with the complete closure of the bag or if the focus is diverted from the specimen bag to start the following phase.
Cleaning and Coagulation	Begins as soon as the focus of the camera is averted from the specimen bag to check for tissue damage, coagulation begins using electricity, or drainage enters the picture.
Gallbladder Retraction	Begins when the specimen bag is last grasped to remove it from the abdomen.
Liver Biopsy	Samples of liver tissue are collected, generally towards the end of the procedures. This phase ends as soon as another instrument for dissection/coagulation/packaging enters the picture.
Other Procedure	Begins once non-cholecystectomy related surgical procedures such as intraoperative ultrasonography, liver or pancreas resection is performed. This phase ends as soon as another instrument for dissection/coagulation/packaging enters the picture.
Intraoperative Cholangiography	The cystic duct is cut and a plastic tube is inserted to apply contrast medium for intraoperative cholangiography. This is an X-ray imaging of the biliary tract to check whether gallstones block the common bile duct and/or the biliary tract is dilated. This phase ends as soon as another instrument for dissection/coagulation enters the picture.

Figure S1. Distribution of video durations (in minutes) in our dataset and Cholec80. Our dataset shows more variability in durations and have longer videos than Cholec80.

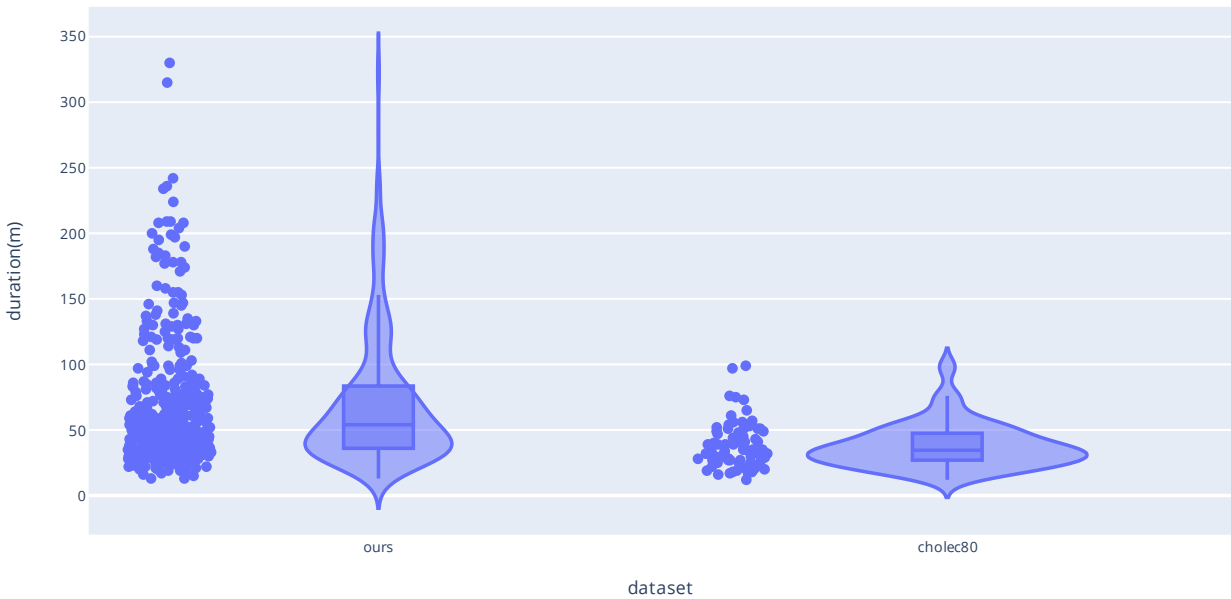


Figure S2. Distribution of phase presence as percentage in total number of videos. Some phases are extremely underrepresented across videos. For example, Gallbladder drainage and Liver biopsy are present only in 0.6% and 0.4% of videos in our dataset, respectively.

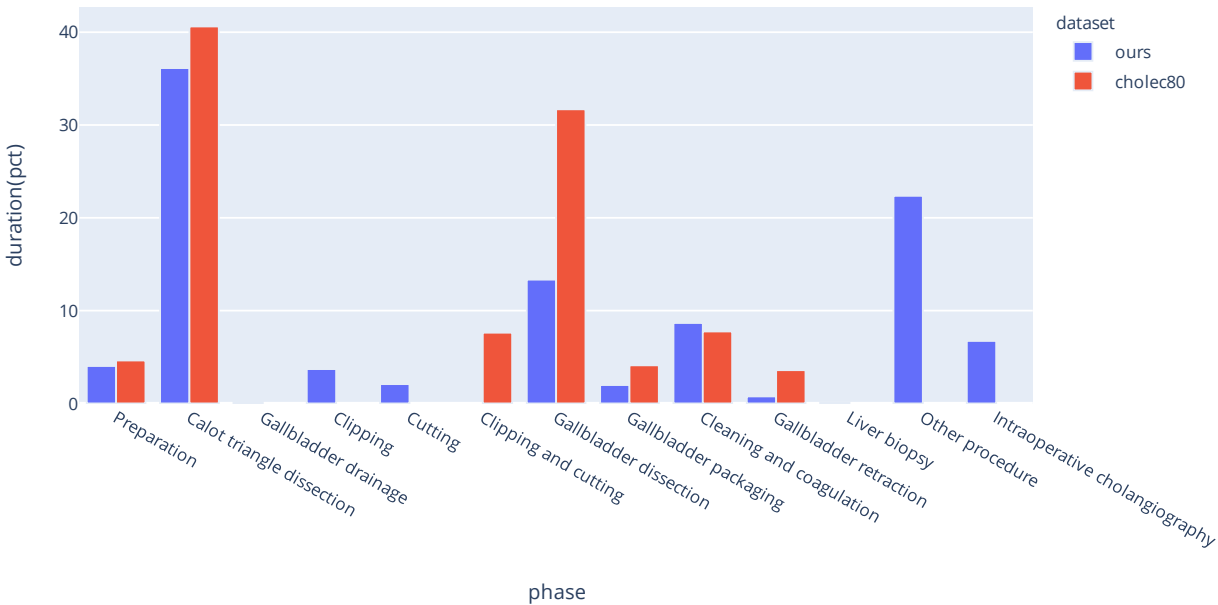


Figure S3. Distribution of phase duration as percentage of total duration in our dataset and Cholec80. The imbalance between phases for both datasets is severe. Gallbladder drainage and Liver biopsy phases are extremely underrepresented in our dataset, with 0.15% and 0.06% duration, respectively.

