

## Background

### LN in Oncology

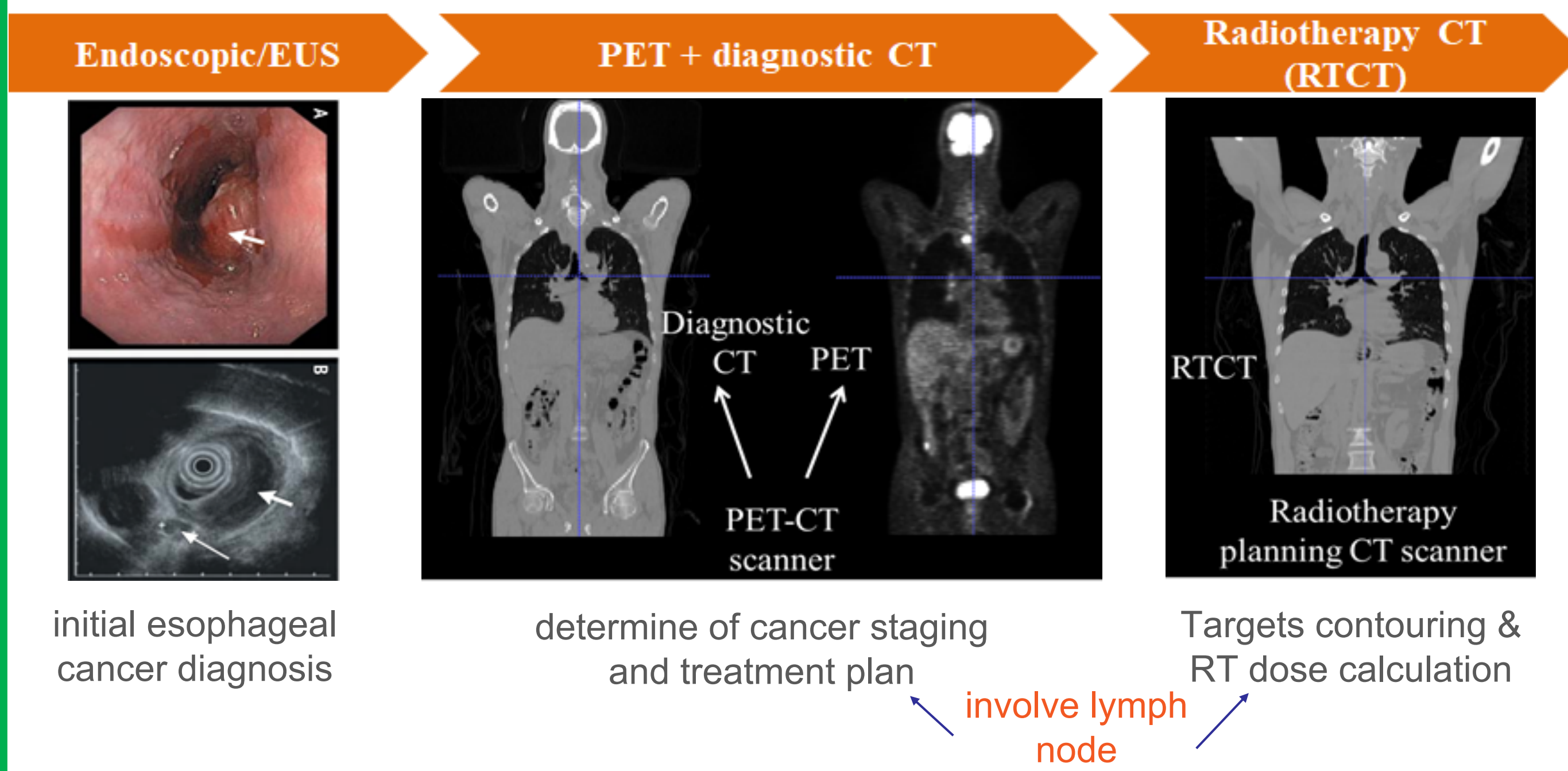


Figure 1. The workflow of esophagus cancer treatment, in which the second and third steps are involved with the lymph nodes.

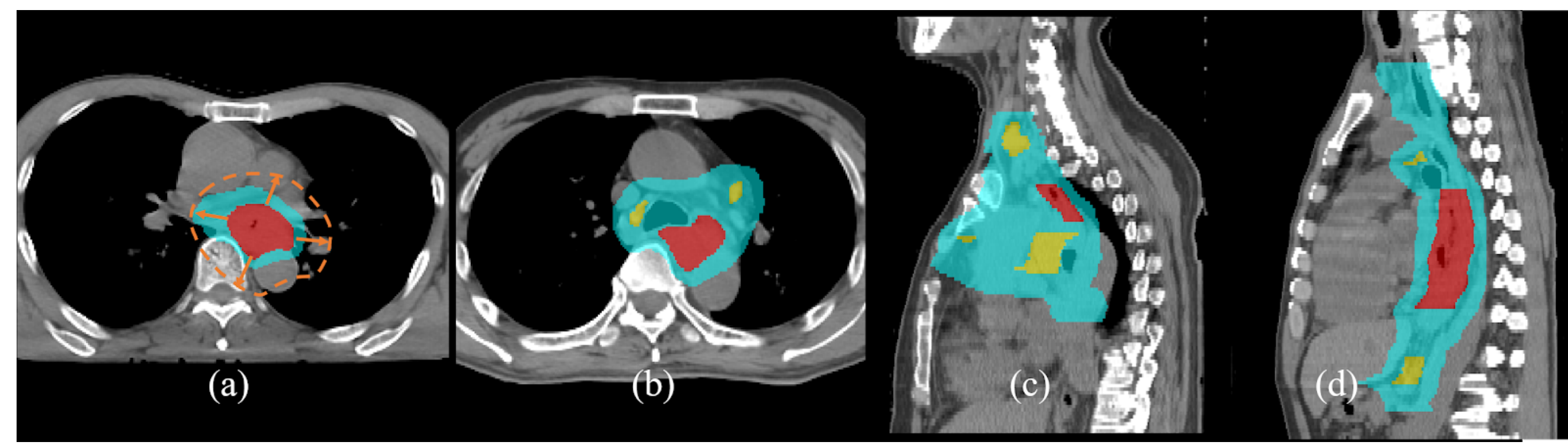


Figure 2. In radiotherapy, the radiation covers the primary tumor and lymph node gross tumor volume (GTV\_LN).

## Challenges

We are the first to address the clinically critical task of detecting, identifying and characterizing GTV\_LNs.

- ❖ Size and shape is in a large variance
- ❖ Radiotherapy is on the non-contrast CT (RTCT)
- ❖ GTV\_LNs have more distributions in smaller sizes than enlarged LNs

In order to do this, we collected 141 patients with esophageal cancer (underwent radiotherapy treatment), in average 4 ~ 5 GTV\_LNs for each patient, 651 GTV\_LNs in total, all of them are on non-contrast CT with the labelled GTV\_LN volume mask.

## Proposed Method

### Dataset

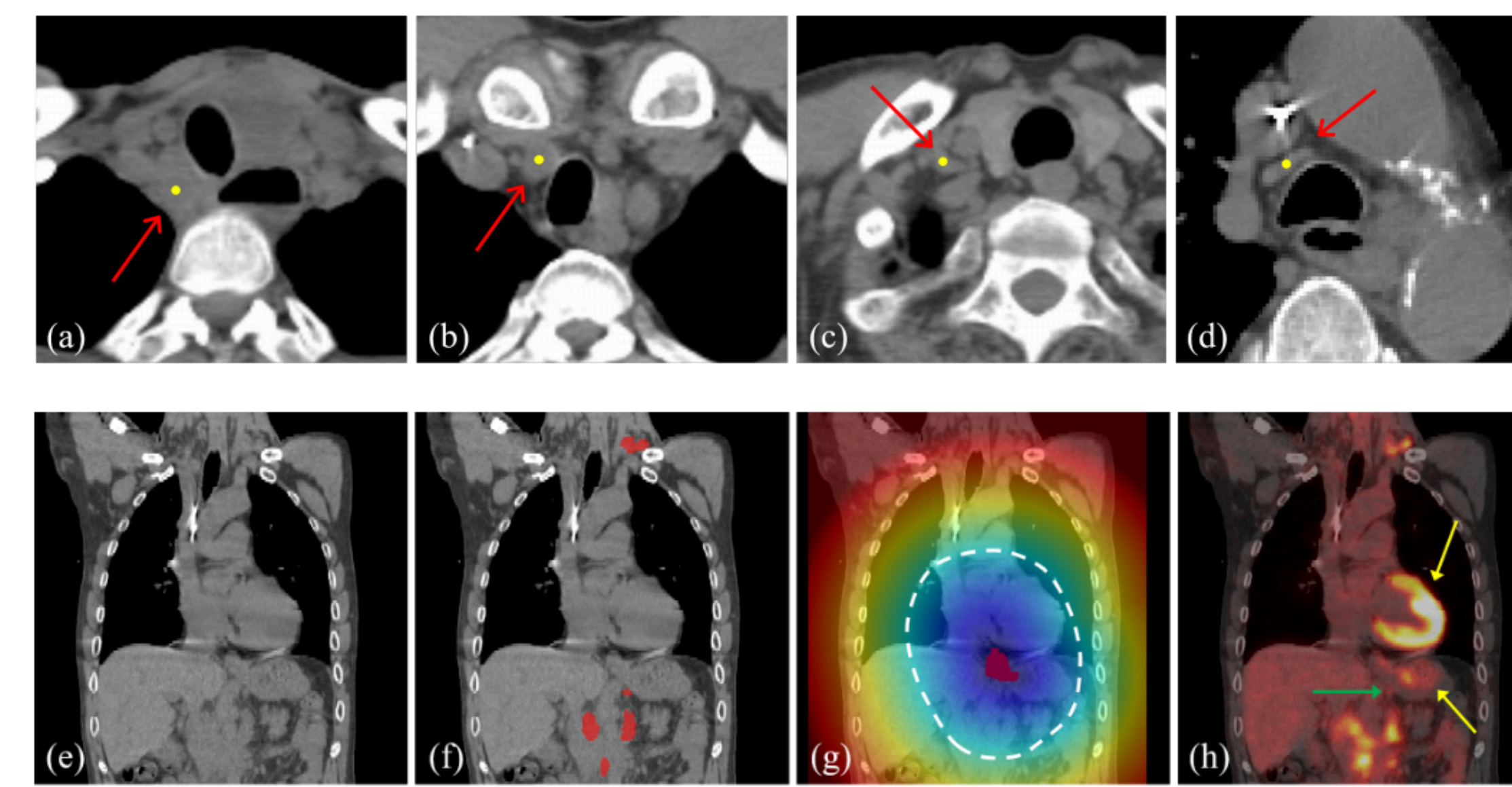


Figure 3. Top row (a-d): examples of the GTV\_LN (red arrow) with varying size and appearance at scatteredly distributed locations. Bottom row (e-h): (e) A coronal view of RTCT for an esophageal cancer patient. (f) The manual annotated GTV\_LN mask. (g) The tumor distance transformation map overlaid on RTCT, where the primary tumor is indicated by red in the center and the white dash line shows an example of the binary tumor proximal and distal region division. (h) PET imaging shows several FPs with high signals (yellow arrows). Two FN GTV\_LN are indicated by green arrow where PET has even no signals on a GTV\_LN.

### Framework

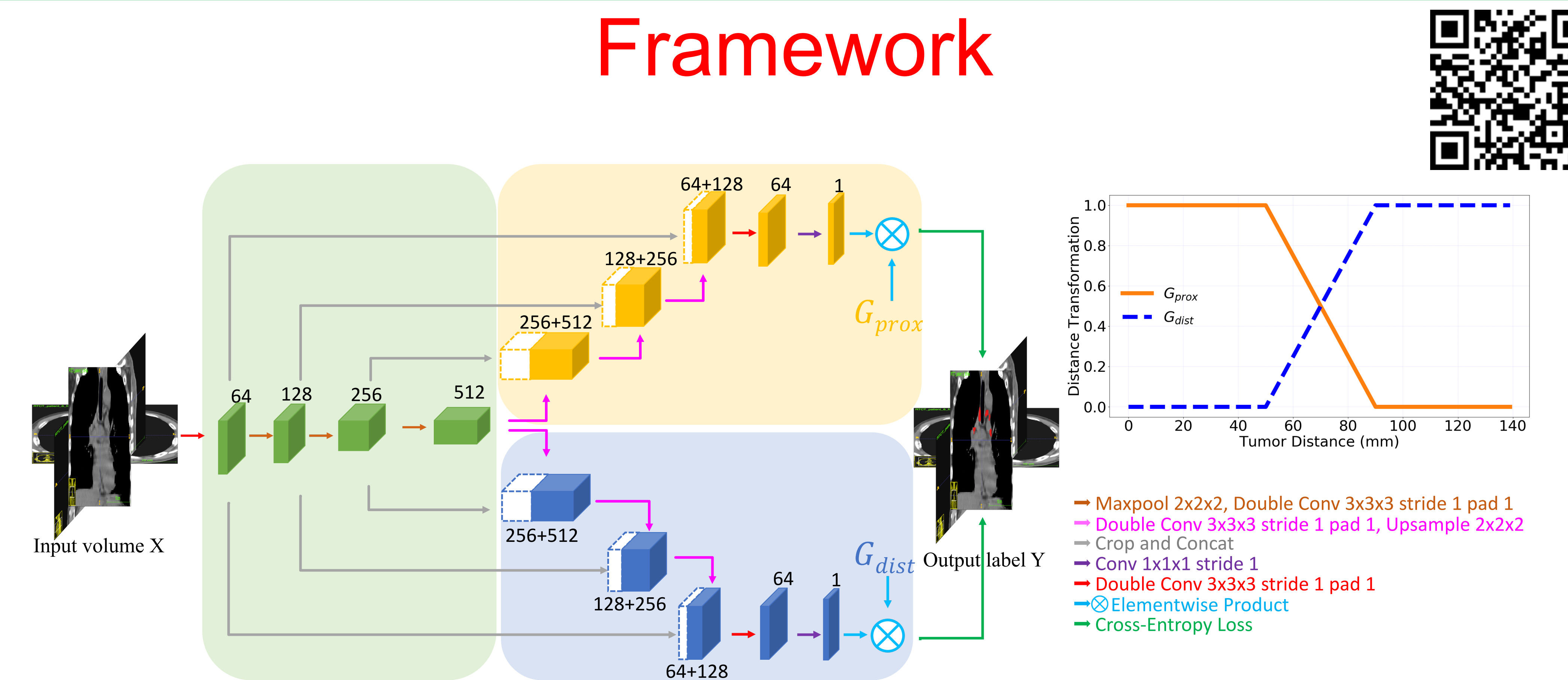


Figure 4. The overall framework of our proposed multi-branch GTV\_LN detection and segmentation method. The light green part shows the encoder path, while the light yellow and light blue parts show the two decoders, respectively. The number of channels is denoted either on the top or the bottom of the box.

## Results

Table 1. Quantitative results of our proposed methods with the comparison to other setups and the previous state-of-the-art.

Methods	single-net	multi-net BG[21]	multi-branch BG (Ours)	multi-branch SG (Ours)	MULAN [17]	
CT	✓				✓	
EF		✓	✓	✓		✓
mRecall	0.66	0.73	0.75	0.76	<b>0.78</b>	0.71
Recall max	0.76	0.82	0.83	<b>0.85</b>	0.84	0.76
mRFOC	0.60	0.68	0.70	0.68	<b>0.72</b>	0.63
FROC @4	0.55	0.67	0.67	0.67	<b>0.73</b>	0.63
FROC @6	0.68	0.71	<b>0.74</b>	0.72	<b>0.74</b>	0.64

## Visualization

RTCT / GTV\_LN MULAN (CT) MULAN (EF) Single-net (CT) Single-net (EF) Multi-net (EF) Multi-branch SG (EF)

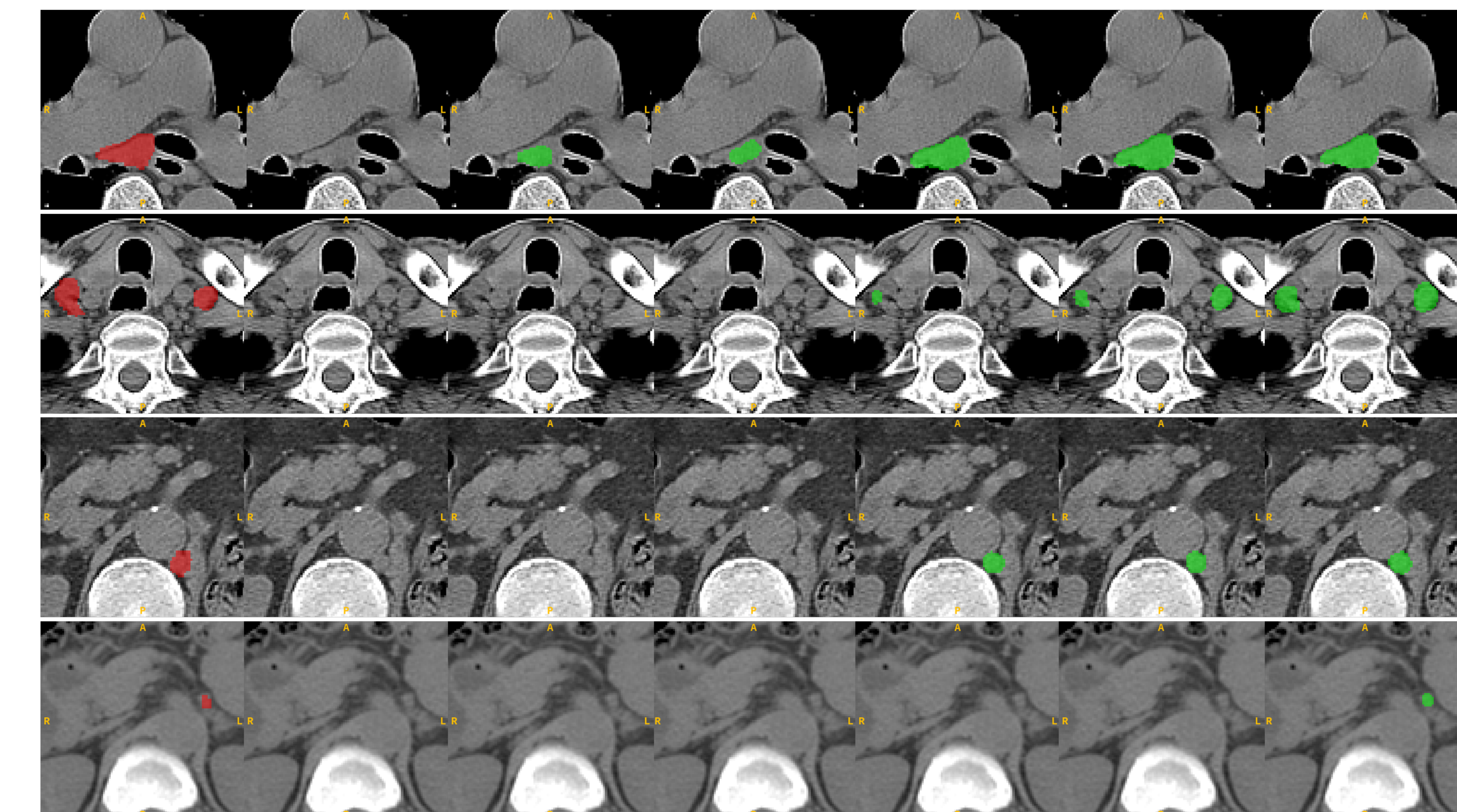


Figure 5. Four qualitative examples of the detection results using different methods. Red color represents the ground-truth GTV\_LN overlaid on the RTCT images; Green color indicates the predicted segmentation masks.