Supplementary File

Figure S1. Dose distribution of > 10 Gy for esophageal cancer patients treated with volumetric modulated arch therapy (VMAT). Red line; primary gross tumor volume (GTVp): green line; primary clinical target volume (CTVp): magenta; primary planning target volume: light green; subclinical clinical target volume (CTV subclinical): pink; subclinical planning target volume (PTV subclinical)

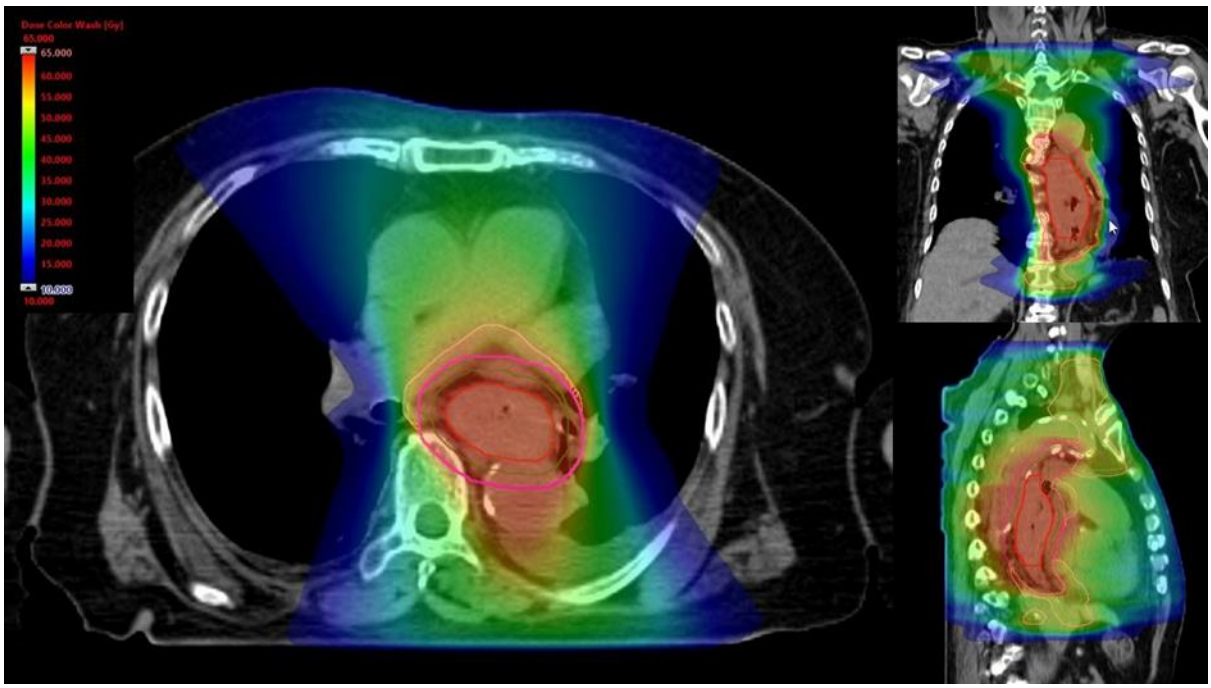

Table S1. Planning target volume dose parameter

PTV	**Tumor location**	**D2 [Gy] median (range)**	**D98 [Gy] median (range)**	**D95 [Gy] median (range)**	**D50 [Gy] median (range)**
PTV primary	Ce-Ut	66.5 (63.9-69.8)	58.5 (53.9-59.5)	59.7 (56.3-60)	63.7 (61.1-65.7)
	Mt-Lt	64.3 (53.3-68.1)	41.3 (4.15-51.1)	59.0 (53.3-60)	62.0 (50.4-69.6)

PTV subclinical	Ce-Ut	60.9 (54.7-69.2)	46.5 (42.8-48.4)	48.1 (45.1-49.9)	52.0 (46.9-58.4)
	Mt-Lt	60.1 (53.2-68.1)	42.4 (6.0-51.1)	45.3 (26.3-52.9)	52.5 (47.9-68.1)

PTV — planning target volume; Ce — cervical esophagus; Ut — upper thoracic esophagus; Mt — middle thoracic esophagus; Lt — lower thoracic esophagus; D2,98,95,50 — dose received by 2. 98, 95, 50% volume of the considered organ

Table S2. Dosimetric results

Volume	**Parameter (median and range)**	**Ce-Ut**	**Mt-Lt**
Lung	V5(%)	52.0(36.4-73.0)	78.2(50.1-98.9)
	V10(%)	38.6(27.0-49.9)	46.6(24.0-75.1)
	V20(%)	18.2(10.9-28.0)	21.2(5.7-32.7)
	MLD (Gy)	10.5(7.5-14.7)	13.5(7.7-18.1)
Heart	V30(%)	7.1(0-66.2)	53.0(0.1-84.6)
	V45(%)	4.2(0-46.3)	25.1(2.8-70.6)
	MHD (Gy)	6.1(0-39.0)	31.5(4.1-44.8)

Ce — cervical esophagus; Ut — upper thoracic esophagus; Mt — middle thoracic esophagus; Lt — lower thoracic esophagus; V5,10,20,30,45 — relative volume of the consider organ receiving 5, 10, 20, 30, 45 Gy; MLD — mean lung dose; MHD — mean heart dose

Table S3. First site of recurrence and radiation field in resectable/unresectable

Recurrences site	**All N (%) n = 47**	**Resectable N (%) n = 23**	**Unresectable N (%) n = 24**
Local	14 (57%)	7 (30.9%)	7 (29.2%)
In-field	13 (28.1%)	7 (30.9%)	6 (25%)
Out-field	1 (2%)	0 (0%)	1 (4.2%)
Regional	8 (17.0%)	3 (13.0%)	5 (20.8%)

In-field	3 (13%)	1 (4.3%)	2 (8.3%)
ENI field	5 (10.6%)	2 (8.7%)	3 (12.5%)
Out-field	1 (2.1%)	0 (0%)	1 (2.1%)
Distant	7 (15%)	4 (17.4%)	10 (41.7%)

resetabe stage Ⅰ–Ⅲ, unresectable stage Ⅳ, ENI — elective nodal irradiation

Table S4. Univariate and Multivariate analyses of overall survival rate

			UMA	**MVA**		
Factor	**No.**	**1-year OS rate (%)**	**p-value**	**p-value**	**HR**	**95% CI**
Age (y)						
> 70 years	27	55%	0.486	ns	—	—
< 70 years	20	60%				
Sex						
Male	37	51%	0.009	ns	—	—
Female	10	82%				
PS						
0–2	39	63%	0.233	ns	—	—
3–4	8	38%				
ICT						
Yes	6	59%	0.673	ns	—	—
No	41	56%				
CRT						
Yes	40	56%	0.735	ns	—	—
No	7	72%				
Tumor stage						
Non-T4	29	70%	0.031	ns	—	—
T4	18	41%				
Stage						

< Ⅳ	23	71%	0.055	ns	—	—
Ⅳ	24	46%				
Dysphagia						
No	34	65%	0.001	ns	—	—
Yes	13	38%				
BMI						
> 18.5	33	70%	0.048	ns	—	—
< 18.5	14	36%				
GTV boost volume [cc]						
< 60	37	55%	0.136	ns	—	—
> 60	10	71%				
NLR						
< 3	19	78%	0.0003	0.026	5.21	1.221 - 22.236
> 3	27	42%				
LMR						
> 3.2	23	56%	0.078	ns	—	—
< 3.2	23	60%				
PLR						
< 207	23	69%	0.001	ns	—	—
> 207	23	44%				
mGPS						
0	18	82%	0.002	ns	—	—
1–2	28	41%				
PNI						
> 40	21	71%	0.02	ns	—	—
< 40	26	41%				

Table S5. Lung dose constraints, lung irradiation dose, and rate of pneumonia in previous studies

First author	Year	Study design	Patient, n	Esophagus site	Prescribed lung constraints	Irradiation lung doses	Incidents pneumonitis
Fan	2019	Prospective	88	Cervical, upper, mid, lower thoracic	V20 ≤ 30%	NA	Grade Ⅰ–Ⅱ: 19.3% Grade Ⅲ: 2.3%
Li	2019	Prospective	53	Upper, mid, lower thoracic	V20 < 28%, mean < 15 Gy	NA	Grade Ⅲ: 6%
Chen	2015	Prospective	50	Cervical, upper, mid thoracic	V20 < 30% V10 < 50% V5 < 60%	NA	Grade Ⅲ: 3.3%
Gerber	2014	Retrospective	41	GEJ, thoracic	V20 < 20% V30 < 15% V40 ＜ 10％	NA	Grade Ⅱ: 2.4%, Grade Ⅲ: 2.3%
Hsiech	2016	Retospective	39	Cervical, upper, mid, lower thoracic	MLD < 15 Gy V20 < 30%	V5 = 67.8%, V20 = 23.4%	Grade Ⅲ/Ⅳ: 0%
our study		Retrospective	47	Cervical, upper, mid, lower thoracic	V20 ＜ 25% V10 ＜50% V5 < 60% MLD ＜20 Gy	Ce-Ut/Mt-Lt V5 = 52.0%/78.2%, V10 = 38.6%/46.6%, V20 = 18.2%/21.2,	Grade Ⅱ: 2.1%, Grade Ⅲ: 8.5%

						MLD = 10.5 Gy/13.5 Gy	

NA — information not available; MLD — mean lung dose; Ce — cervical; Ut — upper thoracic; Mt — middle thoracic; Lt —lower thoracic