Annual report of the esophageal cancer radiation group of the Department of Radiotherapy, Tianjin Medical University Cancer Institute & Hospital

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Background: This report describes the clinical work in esophageal cancer radiation group at the Department of Radiotherapy, Tianjin Medical University Cancer Institute & Hospital (TJMUCH).

Methods: We retrospectively analyzed the clinical data of patients with esophageal cancer who received radiotherapy (RT) at TJMUCH during the 5-year period between 2015 and 2019, including RT procedures, RT methods, treatment types, treatment outcomes and complications, and clinical trials.

Results: In 2015–2019, 1,464 patients with esophageal cancer received RT at the Department of Radiotherapy, TJMUCH. Of these, 1,176 patients received definitive chemoradiotherapy (CRT), 100 received preoperative neoadjuvant CRT, 120 received postoperative adjuvant RT, 49 received post-relapse RT, and 19 received palliative RT for advanced esophageal cancer. Among the patients who received definitive CRT, the incidences of grade 2 and higher radiation esophagitis, radiation pneumonitis, and leukopenia were 19.4%, 3.6%, and 19.7%, respectively; the incidences of grade 3–4 radiation esophagitis, radiation pneumonitis, and leukopenia were 9.4%, 1.2%, and 5.4%, respectively; no grade 5 acute adverse events were observed. Esophageal fistula was the major side effect during the advanced stage of RT. In 2015–2018, 44 patients (5%, 44/846) developed esophageal fistula; of these, 34 cases occurred after RT, and 10 cases occurred during RT. The overall survival was based on the data of 544 patients with esophageal cancer who underwent definitive RT at TJMUCH between March 2010 and September 2016. The median follow-up time was 21.6 months. The median survival was 19.6 months; and the 1-, 3-, and 5-year overall survival rates were 69.4%, 37.2%, and 32.3%, respectively. In 2015-2019, approximately 201 patients participated in different prospective clinical trials.

Conclusions: RT is a crucial and effective treatment for esophageal cancer. Standardized treatment procedures, multidisciplinary cooperation, are the foundations for good treatment effects. Many promising ongoing clinical trials will be helpful to improve the prognosis and survival of esophageal cancer patients in the future.

Keywords: Annual report; esophageal cancer; radiotherapy (RT)

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Introduction

The Department of Radiotherapy of TJMUCH was founded in the 1950s by Prof. Jin Xianzhai, the late founder of oncology in China. It is one of the first and largest radiotherapy (RT) departments in China. After continuous efforts over half a century, it has developed into a well-known cancer radiation therapeutics center in China that integrates scientific research, teaching, and clinical treatments. At present, it is the national teaching and training base for RT physicians, the training base for Elekta, Inc. (Sweden) and the teaching and training base for postgraduates of Tianjin Medical University.

There are 5 wards and 310 beds in the radiation department. At present, 8 accelerators, 2 computed tomography (CT) machines for simulation, 1 magnetic resonance simulation machine, and 2 brachytherapy after-loading machines are in use. The department has approximately 200 staff members, including 50 physicians (10 of whom are chief physicians), 12 physicists, and approximately 50 technicians. In 2019, the area of the clinics and treatment rooms was 12,000 m^2. There are 2 radiobiology laboratories covering an area of approximately 120 m^2. The laboratories are equipped with two −80 ℃ refrigerators and three centrifuges with the capacity of simple processing of clinical specimens and basic molecular biology experiments.

In 2019, the department treated approximately 6,000 new patients, including around 2,000 breast cancer patients, 1,500 lung cancer patients, 500 cervical cancer patients, and 500 patients with head and neck cancer. The esophageal cancer treatment group is part of the Department of Radiotherapy, TJMUCH, 5 physicians and 1 nutritionist are engaged in RT for esophageal cancer. Approximately 300 patients with esophageal cancer are admitted and treated each year (267 in 2019). *Figure 1* shows the number and type of esophageal cancer cases admitted each year since 2015.

Esophageal cancer ranks seventh in incidence and sixth in cancer related death worldwide. Incidence rate is the highest in Eastern Asia with China in top 5 (1). Almost half of esophageal cancer occurs in China with squamous cell carcinoma as the main histology type (2). In China, the disease burden caused by esophageal cancer is heavy (3). Most patients are in the local progression stage of esophageal carcinoma when they seek medical consultation (4,5). According to CROSS and NEOCRTEC5010, neoadjuvant chemoradiotherapy (CRT) improved survival among patients with potentially resectable locally advanced esophageal cancer (6,7). Chen *et al.* demonstrated that cisplatin plus fluorouracil are the standard regimen in dCRT in patients with locally advanced esophageal squamous cell carcinoma (8). Definitive CRT and neoadjuvant CRT plus surgery have become standard therapies for locally advanced esophageal cancer patients. In the new era of immunotherapy, ATTRACTION-3 and KEYNOTE-181 have demonstrated promising antitumor effect of pembrolizumab (anti-PD-1-antibody) for progressed advanced esophageal cancer after first-line therapy (9). KEYNOTE-590 are ongoing to investigate anti-PD-1 pembrolizumab with or without chemotherapy as first-line treatment in patients with advanced esophageal or esophagogastric junction cancer (10). In the report, we will present our clinical work on the RT for esophageal cancer patients and our completed and ongoing clinical trials. We present the following article in accordance with the STROBE reporting checklist (available at http://dx.doi.org/10.21037/atm-20-4064).

Methods

RT procedure for esophageal cancer patients: the esophageal cancer treatment group follows the RT procedure for the treatment of esophageal cancer patients (*Figure 2*).

For all patients diagnosed with esophageal cancer and will receive RT. we first screen patients for indications to determine the type of RT, including definitive CRT, preoperative neoadjuvant CRT, postoperative adjuvant RT, post-relapse RT and palliative RT. A pathology report must be confirmed before treatment. RT techniques include intensity modulated RT (IMRT) and three-dimensional conformal RT (3D-CRT).

Before RT, a well-trained nutritionist assesses the patient's nutrition status with the NRS2002 Nutrition Screening Form and the Patient Generated Subjective Global Assessment (PG-SGA) Nutrition Assessment Form. Patients whose PG-SGA score are more than 4 will receive nutrition therapy, including nutrition education, oral nutrition supplements, nasogastric tube or nasointestinal tube, and percutaneous endoscopic gastrostomy (PEG) depending on different nutrition status before RT simulation. Nutrition therapy is performed by a nutrition therapy team consisting of 2 physicians, 1 nutritionist, 3 nurses, the patient and his or her family. After the start of RT, nutrition assessment is performed every week, and relevant data are recorded.

In addition, we use special metal titanium clips to mark

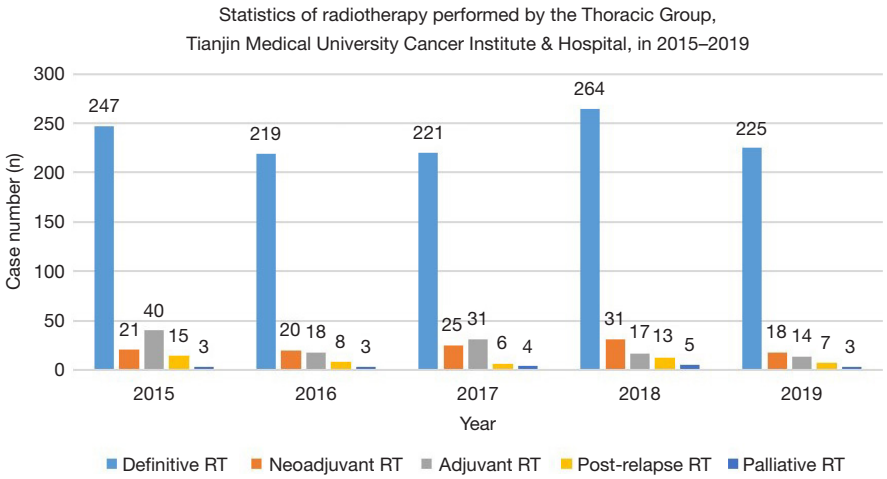

Figure 1 The number and type of esophageal cancer cases admitted each year.

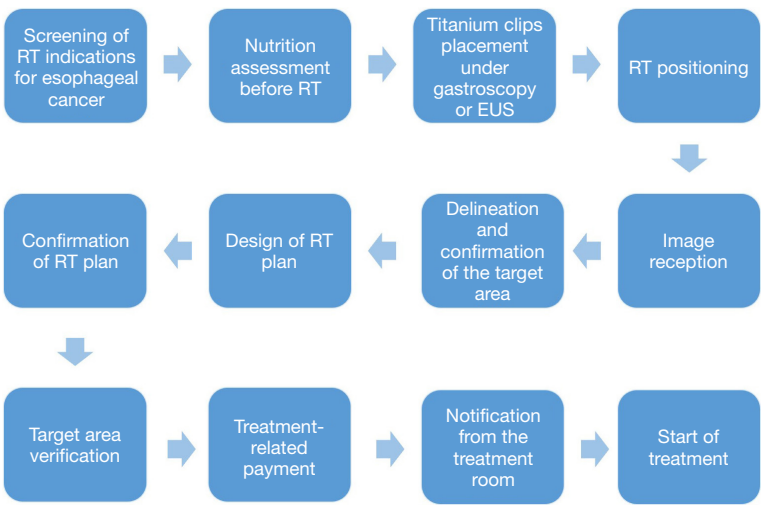

Figure 2 RT procedures for esophageal cancer. RT, radiotherapy.

margins of around 0.5 cm in the superior and inferior directions of esophageal cancer lesions before simulation. The procedure is performed by an endoscopy physician under the guidance of endoscopy or endoscopic ultrasound (EUS). In cases of severe obstruction that impedes the passage of endoscopic ultrasound, only the superior edge is marked. This marking procedure is omitted in patients aged 80 years and older.

RT simulation

For cervical and upper (1/3) thoracic esophageal cancers, the patient is fixed with a head, neck, and shoulder mask with arms on sides. For middle (1/3), lower (1/3), and gastroesophageal junction (GEJ) cancers, the patient is fixed with a chest mesh or negative pressure vacuum pad with arms up. Simulation is performed with routine contrast CT (slice thickness: 3–5 mm). Plain CT is performed in patients allergic to iodine or elderly patients, and patients with other complications. The scan ranges from the laryngeal node to the lower edge of the first lumbar vertebra. RT begins within 2 weeks of simulation.

RT techniques

RT techniques include IMRT and 3D-CRT. IMRT is the

main treatment and includes volumetric modulated arc therapy (VMAT), and RAPID-ARC.

Target area and dosage of IMRT for esophageal cancer

The target area is defined by the physician and is then modified by the associate chief physician and finalized after group meeting with the chief physician and all team members. The target area covers the involved areas and is defined as follows: the gross tumor volume of the primary cancer (GTVp) is determined based on enhanced CT, positron emission tomography (PET)/CT, EUS, and upper gastrointestinal barium test; the upper and lower edges of the tumor are confirmed with titanium clips. The metastatic enlarged lymph node is delineated as regional lymph nodes (GTVnd) if the short diameter is greater than or equal to 5 mm or if the long diameter is greater than or equal to 10 mm based on CT, PET/CT, and EUS; the gross tumor volume (GTV) includes the primary tumor (GTVp) and involved GTVnd as identified on the planning scan. The clinical target volume includes the areas at risk for microscopic disease. Clinical target volume (CTV) was defined as the primary tumor plus a 3 cm expansion superiorly and inferiorly along the length of the esophagus and cardia, and a 0.6 cm radial expansion. The nodal clinical target volume should be defined by a 0.6 cm expansion from the nodal gross tumor volume. The planning target volume expansion (PTV) should be 0.5 cm beyond the CTV. The uncertainties arising from respiratory motion should also be taken into consideration. RT is delivered at 95% PTV: 60 Gy/2.0 Gy/30 f or concurrently at 95% of the planning gross target volume (PGTV): 60 Gy/2.0 Gy/30 f and 95% PTV: 54 Gy/1.8 Gy/30 f.

For cervical and upper thoracic esophageal cancer, the range for nodal irradiation includes the supraclavicular/lower neck lymphatic drainage area, the paraesophageal, paratracheal, subcarinal lymph nodes. For middle thoracic esophageal cancer, the range for nodal irradiation includes paraesophageal, paratracheal, subcarinal lymph nodes and lymph nodes along the left gastric artery (if the left gastric nodes are positive). For lower thoracic esophageal cancer, the range for nodal irradiation includes the paraesophageal nodes, subcarinal, paracardial lymph nodes; and lymph nodes along the left gastric artery. The dosage constrains for normal organs are as follows: 45 Gy for the spinal cord; 30 Gy with maximum of 40% of the total heart volume or 40 Gy with maximum of 30% of the total heart volume; 16 Gy for the maximum of the mean lung dose, 20 Gy with a maximum of 30% of the total lung volume, or 30 Gy with a maximum of 20% of the total lung volume.

Chemotherapy: the main regimen is weekly administration of docetaxel or paclitaxel combined with platinum-based drugs, including docetaxel 25 mg/m^2/week and cisplatin 25 mg/m^2/week or paclitaxel 40 mg/m^2/week and cisplatin 25 mg/m^2/week. An additional regimen is 3-week therapy with fluorouracil plus platinum (fluorouracil 500 mg/m^2 on days 1–5, cisplatin 25 mg/m^2 on days 1–3).

Quality control and treatment assurance

We follow the quality control principles of the treatment room and conduct morning inspections and dose rate measurements every day. During the treatment, two technicians are responsible for positioning and start the treatment only after electronic portal imaging device (EPID) or cone beam CT (CBCT) verification. During the course of RT (20 fractions), esophageal cancer patients undergo additional comprehensive exams and tests, similar to those performed at the initial visit (*Figure 3*) to further define the RT strategy (definitive RT/neo-adjuvant CRT) and adjust the target area.

Prospective clinical trials of RT for esophageal cancer

From January 2015 to December 2019, we participated in and were in charge of 10 clinical trials (*Table 1*) involving definitive RT plus immunotherapy for esophageal cancer, neoadjuvant CRT for esophageal cancer, and nutritional support during RT for esophageal cancer.

Results

In 2015–2019, 80% (1,176/1,464) of the esophageal cancer patients had locally advanced esophageal cancer and underwent definitive CRT. Only 7% patients (100/1,464) had resectable lesions, and they received preoperative CRT; postoperative adjuvant treatment included RT after radical resection of esophageal cancer, as well as endoscopic submucosal dissection (ESD) and endoscopic mucosal resection (EMR) (5 cases in 2019). In addition, more patients with early esophageal cancer (T1bN0M0) are undergoing postoperative endoscopic procedures.

Definitive RT for esophageal cancer: between January 2015 and December 2019, 1,176 esophageal cancer patients received definitive CRT. The incidences of grade 2 and higher radiation esophagitis, radiation pneumonitis, and

leukopenia were 19.4%, 3.6%, and 19.7%, respectively; the incidences of grade 3–4 radiation esophagitis, radiation pneumonitis, and leukopenia were 9.4%, 1.2%, and 5.4%, respectively; no grade 5 acute radiation adverse events were observed (*Table 2*). In 2015–2018, 44 patients (5%, 44/846) developed esophageal fistula; of these, 34 cases occurred after RT, and 10 cases occurred during RT.

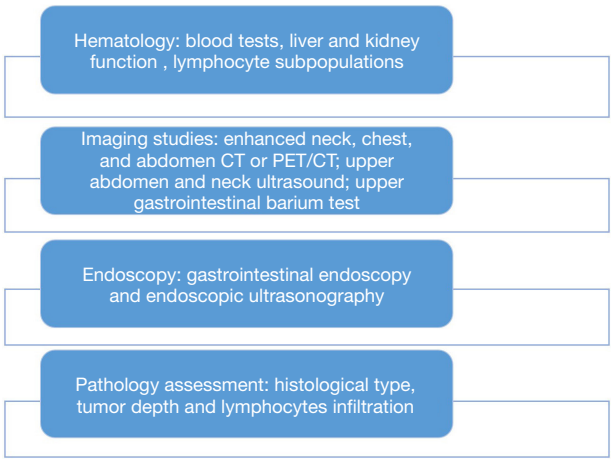

Figure 3 Exams and tests before and during RT for esophageal cancer patients. RT, radiotherapy.

Table 1 Post-RT adverse events in 87 patients receiving neoadjuvant CRT

Adverse events	Grade 0–1	Grade 2	Grade 3	Grade 4
Radiation esophagitis	75	11	1	0
Radiation pneumonitis	86	1	0	0
Low WBCs	51	22	2	2

RT, radiotherapy; CRT, chemoradiotherapy; WBC, white blood cell.

Outcomes of definitive RT for esophageal cancer: The long-term overall survival rate is not available for patients from 2015–2019. Thus, we used data from 544 patients with esophageal cancer who underwent definitive RT at TJMUCH between March 2010 and September 2016 instead. Ninety-nine patients were women, and 445 were men; 328 were under 65 years, and 216 were aged 65 years or older. Fifty patients had cervical esophageal cancer, 189 had upper thoracic esophageal cancer, 243 had middle thoracic esophageal cancer, and 62 had lower thoracic esophageal cancer. A total of 353 patients received concurrent CRT, and 191 patients did not. According to Union for International Cancer Control/American Joint Committee on Cancer (UICC/AJCC) staging (Edition 8), 81 were in stage II, 102 were in stage III, and 361 were in stage IVA. *Table 3* shows the general characteristics of these patients. Follow-up lasted till July 15, 2018. The median follow-up time was 21.6 months, and 241 patients (44.30%) died. The median survival was 19.6 months; and the 1-, 3-, and 5-year overall survival rates were 69.4%, 37.2%, and 32.3%, respectively. The above survival rates were 83.8%, 59.3%, and 53.9% for patients in stage II, respectively; 78.4%, 40.1%, and 40.1% for patients in stage III, respectively; and 63.2%, 31.2%, and 25.7% for patients in stage IVA, respectively, (P<0.001) (*Figure 4*).

Neoadjuvant CRT for esophageal cancer

During the 5-year period (through December 2019), 100 patients received neoadjuvant CRT at our hospital. Of 87 patients who were followed for more than six months, 35 (40.2%) achieved pathological complete remission (pCR) after neoadjuvant CRT (40 Gy/20 f). Preliminary data show that sex, age, tumor location, stage, and course of chemotherapy had no significant effect on the pCR rate

Table 2 Adverse reactions to definitive RT from January 2015 to November 2018 (n=846)

RT-related adverse reactions	Grade 0–1	Grade 2	Grade 3	Grade 4	Grade 5	Total
Radiation esophagitis	542 (71.2%)	148 (19.4%)	53 (7.0%)	18 (2.4%)	0 (0.0%)	761
Radiation pneumonitis	724 (95.3%)	27 (3.6%)	9 (1.2%)	0 (0.0%)	0 (0.0%)	760
Low WBC	568 (74.9%)	149 (19.7%)	32 (4.2%)	9 (1.2%)	0 (0.0%)	758
Low neutrophils	652 (89.3%)	49 (6.7%)	22 (3.0%)	7 (1.0%)	0 (0.0%)	730
Low hemoglobin	661 (89.2%)	68 (9.2%)	10 (1.3%)	2 (0.3%)	0 (0.0%)	741
Low platelets	686 (93.8%)	30 (4.1%)	9 (1.2%)	6 (0.8%)	0 (0.0%)	731

RT, radiotherapy; WBC, white blood cell.

Table 3 Prognostic analysis of general clinical factors (n=544)

Variable	n (%)	HR (95% CI)	P value
Sex			0.858
Male	445 (81.80)	1	
Female	99 (18.20)	0.971 (0.700–1.346)	
Age (y)			0.010
<65	328 (60.29)	1	
≥65	216 (39.71)	1.396 (1.083–1.800)	
Tumor location			0.061
Cervical	50 (9.19)	1	
Upper thoracic	189 (34.74)	0.965 (0.611–1.524)	0.878
Middle thoracic	243 (44.67)	1.341 (0.861–2.089)	0.194
Lower thoracic	62 (10.40)	1.521 (0.879–2.631)	0.134
Concurrent CRT			0.001
Yes	353 (64.89)	1	
No	191 (35.11)	0.636 (0.492–0.822)	
KPS			0.309
<80	237 (43.57)	1	
≥80	307 (56.47)	0.877 (0.680–1.130)	
T staging			<0.001
T_2	40 (7.35)	1	
T_3	157 (28.86)	1.764 (0.902–3.448)	0.097
T_4	347 (63.79)	2.716 (1.435–5.141)	0.002
N staging			<0.001
N_0	132 (24.26)	1	
N_1	193 (35.48)	1.144 (0.807–1.622)	0.450
N_2	172 (31.62)	1.599 (1.127–2.268)	0.009
N_3	47 (8.64)	2.353 (1.484–3.730)	<0.001
UICC/AJCC staging (Edition 8)			<0.001
II	81 (14.89)	1	
II	102 (18.75)	1.397 (0.841–2.322)	0.197
IVa	361 (66.36)	2.136 (1.404–3.247)	<0.001

CRT, chemoradiotherapy; UICC/AJCC, Union for International Cancer Control/American Joint Committee on Cancer.

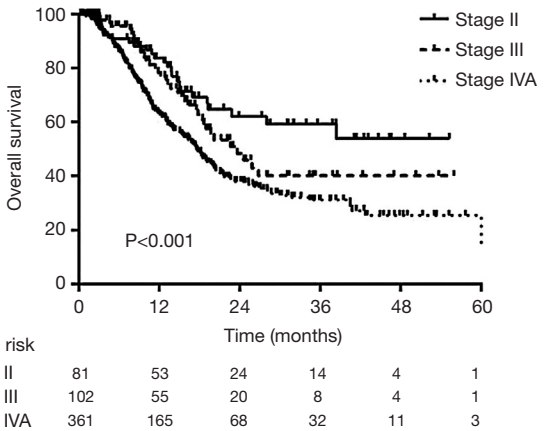

Figure 4 Kaplan-Meier overall survival curves for 544 patients after definitive CRT. CRT, chemoradiotherapy.

after neoadjuvant CRT (P>0.05) (*Table 4*).

Table 1 shows the adverse reactions to neoadjuvant RT. Most grade 2 or above adverse reactions were radiation esophagitis (14%, 12/87) and low WBCs (27%, 24/87).

Prospective clinical trials of RT for esophageal cancer

From January 2015 to December 2019, we participated in and were in charge of 10 clinical trials (*Table 5*). Approximately 201 patients were enrolled, accounting for 13.6% (201/1,276) of esophageal cancer patients undergoing definitive or neoadjuvant CRT. The main research topics were definitive RT plus immunotherapy for esophageal cancer, comprising two phase Ib studies and one phase III prospective multicenter study (total case number: 42); neoadjuvant CRT combined with surgery for esophageal cancer, comprising three studies with 69 patients (69% of the patients undergoing neoadjuvant CRT); and a nutritional support study during definitive CRT for esophageal cancer (total case number: 27).

Discussion

This is the first annual report of the esophageal cancer treatment group of the Department of Radiotherapy, Tianjin Medical University Cancer Institute & Hospital. This report describes the clinical data of 1464 esophageal cancer patients who underwent RT at our hospital during the 5-year period between January 2015 and December 2019. Our hospital is one of the largest esophageal cancer RT centers in China and the world.

Table 4 Clinical characteristics of patients receiving neoadjuvant CRT

Variable	n	pCR		P value
		pCR (n=35)	Residual disease (n=52)	
Sex				0.696
Male	81	32	49	
Female	6	3	3	
Age (y)				0.829
<60	46	19	27	
≥60	41	16	25	
Smoking				0.421
Yes	68	26	42	
No	15	5	10	
Positive lymph nodes				0.489
N0	10	3	7	
N+	77	32	45	
Tumor location				0.434
Upper	10	3	7	
Middle	60	23	37	
Lower	17	9	8	
T staging				0.313
T2–T3	49	22	27	
T4	38	13	25	
Four-cycle concurrent chemotherapy				0.331
Yes	73	31	42	
No	14	4	10	

CRT, chemoradiotherapy; pCR, pathological complete remission.

We have been standardizing RT procedures for esophageal cancer. RT is a complex procedure that encompasses the entire duration, from admission to the end of treatment, and requires multidisciplinary cooperation between internal medicine, RT, nutrition, surgery, and endoscopy. In this paper, we also present the details of the RT procedures. Our experience shows that pretreatment nutrition assessment (11-15), pretreatment nutrition therapy (16,17), pretreatment delineation of the target area, and efficacy evaluations throughout the course of treatment are all important.

Our standardized RT procedures ensure good treatment outcomes. The results show that the median survival was 19.6 months and the 1-, 3-, and 5-year overall survival rates were 69.4%, 37.2%, and 32.3%, respectively, which are superior to other reports from China and abroad (3-year survival: 20% to 30%) (18-22). We achieved superior results in resectable early esophageal cancer (T2, T3) patients relative to other studies (23). In addition, according to the Japan Clinical Oncology Group Study JCOG 0508 report this year, for patients in stage T1b receiving preventive CRT, the 3- and 5-year overall survival rates were as high as 91% and 89%, respectively (24,25). These data indicate that RT is an effective treatment for early esophageal cancer.

We are the first center in the world to investigate the effect of definitive RT/CRT combined with immunotherapy in patients with esophageal cancer. This study includes two phases. During phase one, patients who cannot tolerate or are unwilling to receive chemotherapy enrolled to the trial to test the safety of definitive RT combined with immunotherapy. Our phase two study was about definitive CRT combined with immunotherapy. Preliminary data shows that CRT plus immunotherapy is potentially effective, the incidence of grade 3–4 side effects in the CRT plus immunotherapy group is acceptable, indicating that it is a promising treatment option. At present, several multicenter clinical studies are underway in China and abroad, such as NCT 03278626 and NCT 03377400 (26,27).

In the past five years, 100 patients received preoperative CRT in our hospital, and 69 were enrolled in clinical trials. A total of 87 patients were included in analysis, and the results showed that 35 patients (40.2%) achieved pCR after neoadjuvant CRT (40 Gy/20 f), which is consistent with the results from the CROSS study (overall pCR rate: 29%; 49% of patients had squamous cell carcinoma) and the NEOCRTEC5010 study (pCR rate: 43.2%) (5,6). We evaluated tumor remission and tumor-infiltrating lymphocytes (TILs) during CRT as predictors of pathologic response and prognostic markers for patients with locally advanced ESCC treated with neoadjuvant CRT (neo-CRT) or definitive CRT (28). Furthermore, we conducted a prospective clinical study (NCT 02959385). In this study, esophageal cancer patients with CCR were randomized to undergo surgery or definitive CRT after neoadjuvant CRT. The preliminary survival analysis showed there was no significant difference in progression-free survival between these two groups. This study was chosen as oral presentation in the special session for esophageal cancer of the 2019 American Society for Radiation Oncology

Table 5 Clinical trials and number of participants

Title	Number of participants
Efficacy and safety of weekly nab-paclitaxel plus cisplatin with concurrent intensity-modulated RT in patients with inoperable, locally advanced esophageal cancer	17
A multicenter prospective phase II/III clinical study of tegafur capsule plus SIB-IMRT versus SIB-IMRT alone in elderly patients with esophageal cancer/esophagogastric junction cancer	42
A prospective multicenter randomized controlled phase III clinical trial of the efficacy of paclitaxel, cisplatin, and fluorouracil versus paclitaxel and cisplatin plus concurrent RT in neoadjuvant treatment for locally advanced esophageal squamous cell carcinoma	10
A multicenter phase II randomized clinical study of concurrent CRT with different doses (50.4 *vs*. 59.4 Gy) in different target areas (selected area *vs.* involved area) in patients with locally advanced thoracic esophageal squamous cell carcinoma	4
A prospective single-center phase II clinical study of the efficacy and safety of definitive CRT versus surgery in patients with initial inoperable esophageal squamous cell carcinoma who became operable after neoadjuvant CRT	3
A phase Ib exploratory study of the effect of PD-1 antibody SHR-1210 combined with CRT for locally advanced esophageal squamous cell carcinoma	20
A phase Ib exploratory study of the effect of PD-1 antibody SHR-1210 combined with RT for locally advanced esophageal squamous cell carcinoma	20
A single-center prospective study of the effect of different nutritional therapy routes on improving the nutritional status of esophageal cancer patients during concurrent CRT	27
A phase II randomized controlled clinical trial of definitive CRT versus preoperative CRT combined with surgical treatment in patients with esophageal squamous cell carcinoma	56
A phase III prospective study of PD-1 antibody combined with CRT for locally advanced esophageal squamous cell carcinoma	2

RT, radiotherapy; SIB-IMRT, simultaneous integrated boost IMRT; CRT, chemoradiotherapy; PD-1, programmed death-1.

(ASTRO). High pCR and 3-year survival rates after neoadjuvant CRT challenge the necessity of surgery when patients achieving pCR (5-6,29). At present, the criteria for clinical complete response (cCR) varies from different centers. A more accurate criteria is needed to increase the consistency between cCR and pCR.

We attach great importance to nutritional support during the course of RT for esophageal cancer. Nutrition assessments are performed in more than 95% of esophageal cancer patients scheduled for RT and nutritional therapies are given to more than 80% of patients. Extensive nutritional assessment and intervention improve the tolerance of CRT and the treatment completion rate (>80%). Preliminary data show that nutrition therapy during CRT also reduces the incidence of esophagitis during and after RT.

Conclusions

Standardized treatment procedures, multidisciplinary cooperation, and the integration of clinical treatments and clinical trials are of great importance in esophageal cancer treatment and are the foundation for good treatment outcomes. We hope the outcomes of ongoing clinical trials with more patients enrolled in the near future could further improve treatment outcomes.

Acknowledgments

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Footnote

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Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at http://dx.doi.org/10.21037/atm-20-4064). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. All procedures performed in this study involving human participants were in accordance with the Declaration of Helsinki (as revised in 2013). The ethical approval and individual informed consent were waived.

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