Overview on Gastric Cancer

Chapter 2

Defining appropriate field arrangements for the adjuvant postoperative therapy of gastric cancer

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1. Introduction

The optimization of the treatment plans provided by the conformational radiotherapy should improve the coverage of the target volume, the dose distribution with respect to the defined critical organs (liver, kidneys, intestine, duodenum). A four or five-beam technique appears to decrease toxicity and schould be prefered in practice.

2. Three dimensional conformal radiation therapy

2.1. Balistics

At the Mayo Clinic, a retrospective review of 63 patients treated with postoperative radiotherapy with or without chemotherapy, suggested improved toxicity outcomes associated with use of four or more radiation fields [1]. In this series, 22% of patients treated with AP-PA techniques developed grade 4 or 5 complications vs. 4% of patients treated with 4 or more fields. Soyfer et al implemented a non-coplanar 3-dimensional conformal RT (3D CRT) technique that used four fields, including right and left laterals, an anterior craniocaudal oblique field, and an anterior caudal-cranial oblique field [2]. A total of 19 patients each underwent planning using three techniques: non-coplanar 3D CRT, AP-PA, and four-field box. The 3D CRT technique resulted in equivalent clinical target volume coverage with significantly decreased dose to the kidneys and spinal cord. The use of multi-beam techniques significantly reduces toxicity[3]. Twenty-two percent of patients had grade 4 toxicity if a two-beam technique was used compared with 4% for a technique with at least four beams ($p = 0.045$) according to

EORTC-RTOG expert opinion [3]. The optimization of the treatment plans provided by the conformational radiotherapy should also improve the coverage of the target volume, the dose distribution with respect to the defined critical organs (liver, kidneys, intestine, duodenum). A four- or five-beam technique appears to decrease toxicity by improving the conformation factor (percentage of the target target volume receiving a dose ≥ 45 Gy), protection of healthy tissues (ratio of healthy tissue volume receiving a dose ≥ 45 Gy on the volume of the isodose 45 Gy) [4]. A split-field mono-isocentric conformal technique using six radiation field, was developed at the Peter MacCallum Cancer Centre in Australia [5]. This technique divides the planning target volume (PTV) into two abutting sections, the upper half including the tumor bed, anastomosis, and splenic hilar nodes and the lower half including the subpyloric, pancreaticoduodenal, and paraaortic nodes. The upper half is treated with an anterior field, a posterior field, and a left lateral field that is angled as necessary to avoid the spinal cord. The lower half is treated with a right lateral, left lateral, and anterior field that are angled to minimize kidney dose. A total of 15 patients were each planned using the split-field conformal technique and a standard AP-PA arrangement. Dose-volume histogram comparisons revealed improved PTV coverage and lower RT doses to the kidneys and spinal cord using the split-field conformal technique [5,6]. A four- or five-beam balistic standardization has been proposed [7]. A technique with four orthogonal beams can be used, or better, a five-beam technique with some variability inciting to propose two types of standardized balistics [7] (Table 1).

Table 1: Balistics with 4 or 5 beams after optimization in gastric cancer treatments in the postoperative situation. Two groups of patients possible. Group 2 accounts for 75 % of the situations and group 1: 25 % [7].

Obliquity	Beam 1	Beam2	Beam3	Beam4	Beam5
Cardia:					
Group 1	180°	135°	93°	42°	338°
Group 2	180°	90°	45°	349°	329°
Gastric Fundus					
Group 1	180°	90°	44°	0°	325°
Group 2	181°± 5°	135°±2°	93°±4°	43°± 12°	333°±7
Antrum					
Group 1	181°±5°	134°±-1.6°	93°±4.8°	43°±12°	335°±4°
Group 2	180°	94°±9°	47° ±8°	353°±11°	307°±26°

2.2. Dosimetry

A three-dimensional treatment plan is realized with correction of the inhomogeneities. The treatment plan should respect the recommendations of the International Commission on Radiation Units and Measurements (ICRU Reports 50 and 62). The dose-volume histograms of each volume are made. Ninety-five percent of the target volume receives more than 95% of the prescribed dose. Inhomogeneities of dose will be accepted with an interval between +7%

of prescribed dose and -5% (calculation volume less than 1.8 cm) [4].

2.3. Organs at risk and dose constraints

The lungs, kidneys, liver, heart and spinal cord are delineated and defined as an organ at risk. Recommendations were made, including those from the European Organization for Research and Treatment of Cancer (EORTC) group in a preoperative situation [3]. The maximum dose to the marrow should not exceed 45 Gy. The percentage of total pulmonary volume receiving 20 Gy or more (V20) is ideally 30% or less. The liver also represents a critical organ. The liver volume receiving 30 Gy or more (V30) is less than 30%; The average dose to the liver is less than 21 Gy. If lateral beams are used, they provide a limited dose of 20 Gy [4]**.**

3. Intensity-modulated radiation therapy

Several recent reports have examined intensity modulated radiation therapy (IMRT) for the delivery of postoperative radiation. In order to assess the potential advantages of IMRT for the delivery of adjuvant radiation, dosimetric comparison were made in fwe series [8,9]. The IMRT plans, compared to conventional 3D planning, reduced dose to the kidney [8,9]. Although most series of IMRT have been limited to dosimetric plan comparisons, one small series described outcomes among 7 patients treated with IMRT. The IMRT plans provided excellent target coverage and significantly reduced liver and kidney doses when compared with anterior-posterior and three-field plans. No patient experienced greater than grade 2 acute gastrointestinal toxicity. A number of limitations of IMRT were identified. There is a need for detailed information regarding organ motion in the upper abdomen and implementation of breath hold or gating techniques may be necessary prior to adoption of IMRT in routine clinical practice [9].

4. References

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