

Survey of radiation oncologists: Practice patterns of the management of stage I seminoma of testis in Canada and a selected group in the United States

Richard Choo, MD,¹ Howard Sandler, MD,² Padraig Warde, MD,³
George Hruby, MD,¹ Gerrit DeBoer, PhD¹

¹Department of Radiation Oncology, Toronto-Sunnybrook Regional Cancer Centre, Toronto, Ontario, Canada

²Department of Radiation Oncology, University of Michigan Medical Center, Ann Arbor, MI, U.S.A.

³Department of Radiation Oncology, Princess Margaret Hospital, Toronto, Ontario, Canada

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Objective: To evaluate practice patterns of the management of stage I seminoma of testis in Canada and a selected group in the United States.

Materials and methods: Survey among radiation oncologists treating genitourinary (GU) tumors in Canada and the RTOG GU committee members in the United States between January and March 2001.

Results: Response rate was 78% (73/93) in Canada and 67% (24/36) in the United States. Eighty-four percent described their clinical practice as a university affiliated teaching center, and 16% as community-based or private practice. Sixty-two percent, 31% and 7% would manage 1-5, 6-10 and ≥ 11 cases per year respectively. Almost all would perform chest x-ray (99%) and CT scan of abdomen and pelvis (100%) as staging investigation following radical inguinal orchiectomy. Forty percent also arranged CT scan of chest, while only 18% routinely

obtained lymphangiogram. Seventy-eight percent offered surveillance as a management option and estimated that 20% (median) of patients would choose surveillance in their practice. Among four management options: (1. surveillance, 2. radiotherapy (RT) to the para-aortic region, 3. RT to the para-aortic and ipsilateral pelvis ('dog-leg'), 4. single-agent chemotherapy), the order of first preference was option 1 (44%), 2 (42%), and 3 (14%) for patients who wish to preserve fertility. When fertility was not a major concern, it was option 2 (43%), 3 (39%), and 1 (17%). The commonest dose-fractionation schedule was 25 Gy/20 fractions (68%). Others included 25 Gy/15 f (15%), and 25.5 Gy/17 f (4%). Forty-five percent chose the para-aortic region, while 53% used the 'dog-leg' as RT volume. Twenty-nine percent reduced RT volume from the 'dog-leg' to the para-aortic region as the result of MRC Phase III study published in 1999.

Conclusion: There are significant variations in the practice pattern of the management of stage I seminoma of testis among radiation oncologists in Canada and a selected group in the United States.

Key Words: seminoma of testis, survey, practice pattern

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Address correspondence to Dr. Richard Choo, Department of Radiation Oncology, Toronto-Sunnybrook Regional Cancer Centre, 2075 Bayview Avenue, Toronto, ON M4N 3M5 Canada

Introduction

Management options of stage I seminoma of testis are diverse and include surveillance with the reservation of radiotherapy (RT) or chemotherapy for the salvage of relapse, adjuvant RT, and adjuvant chemotherapy. The traditional approach for stage I pure seminoma of testis has been radical inguinal orchiectomy followed by adjuvant external beam RT to the para-aortic and ipsilateral pelvic region. While this strategy has provided excellent outcome with long-term survival of greater than 95%,¹⁻³ there has been

increasing concern with regard to potential long term radiation-induced morbidity which includes impaired spermatogenesis, chronic gastrointestinal complication and second malignancy. This concern, together with the availability of improved imaging techniques and more effective salvage treatment for relapse, has led to the exploration of more conservative approaches. Surveillance series have reported that the relapse rate in patients managed with surveillance alone was in the range of 15%-20% with the majority of recurrences limited to the para-aortic lymph nodes.⁴⁻⁶ Furthermore, almost all relapses were successfully salvaged by RT and/or chemotherapy. Thus, surveillance with reservation of RT or chemotherapy for salvage of relapse has become a viable therapeutic option as it provides a survival rate equivalent to that achieved with standard adjuvant RT. There has also been an effort to reduce the morbidity of RT by reducing RT target volume.⁷⁻⁹ The Medical Research Council (MRC) trial reported that RT treatment volume confined to the para-aortic lymph nodes provided an equivalent relapse-free survival with reduced hematologic, gastrointestinal and gonadal toxicity, in comparison to more traditional treatment volume encompassing the para-aortic and ipsilateral pelvic region ('dog-leg' field)⁹. Recently, one or two courses of single-agent adjuvant chemotherapy has also been explored in lieu of adjuvant RT. Preliminary results suggested that this limited chemotherapy was generally well tolerated with minimal disruption of normal lifestyle and no major impact on fertility.¹⁰⁻¹²

As more management options are available and explored, there has been growing diversity in the management of stage I seminoma of testis. While some offer surveillance as one of the management choices, others routinely recommend adjuvant RT. There has also been increasing variation with respect to the dose and volume of adjuvant RT, as strategies to reduce the morbidity of RT have been examined. A survey was conducted among radiation oncologists to evaluate practice patterns of the management of stage I seminoma of testis in Canada and a selected group in the United States.

Materials and methods

A survey was conducted between January and March 2001. In Canada, radiation oncologists treating genitourinary tumors in provincial regional cancer centers were identified and subjected to the survey. In the United States, the survey was limited to the radiation oncologists in the Radiation Therapy

Oncology Group (RTOG) Genitourinary Committee. Medical oncologists were not surveyed.

The questionnaire used in the survey is shown in Table 1. It consisted of three sections:

- Physician's practice profile,
- Management approaches for stage I seminoma of testis which included: the extent of radiological investigation, the prevalence of using surveillance strategy, and a ranking of management options in the absence or presence of fertility preservation concern,
- Adjuvant RT issues including dose-fractionation schedules and RT treatment volume.

Also, a particular question was asked to determine whether RT treatment volume was reduced from the traditional 'dog-leg' field to the para-aortic field as the result of the MRC study published in 1999.⁹

The collected data were systematically entered into an Excel spreadsheet. Analysis was done with SAS Version 8 program (SAS Institute Inc.).

Results

The number of questionnaires returned was 97 (out of 129 sent) with a response rate of 75.2%. In Canada, 73 of 93 surveyed (78%) responded. In the United States, 24 of 36 (67%) replied. The distribution of responders by province and country is shown in Table 2. All responders were radiation oncologists actively involved in the management of testicular seminoma cases in their practice.

Practice profile

Eighty-two responders (84%) described their clinical practice as a university-affiliated teaching center, while 15 (16%) reported community-based or private practice. The proportion of radiation oncologists working in a university-affiliated teaching center was similar between Canada and the United States (85% versus 83%). When asked about the number of new testicular seminoma cases seen per year, 60 (62%) stated that they would see 1-5 new cases per year. Thirty (31%) and seven responders (7%) would treat 6-10 and ≥ 11 cases per year respectively.

Radiological investigations following radical inguinal orchiectomy

Almost all indicated that they would perform chest x-ray (99%) and CT scan of abdomen and pelvis (100%). There was only one that would not obtain chest x-ray; however, this responder indicated that CT scan of chest would be preformed. Lymphangiogram was a part of staging investigations in only 18%. Forty

TABLE 1. Questionnaire

Survey: Stage I Pure Seminoma of Testes

I Your Practice Profile

1. How would you describe your clinical practice? (please check appropriate box).
 - a) Community/ Private Practice ☐
 - b) University affiliated teaching centre ☐
2. How many patients with seminoma (of any stage) do you see per year? (please check appropriate box).
 - a) 0 ☐ (If your answer is 0, please do not complete the remainder of the questionnaire)
 - b) 1-5 ☐
 - c) 6-10 ☐
 - d) ≥ 11 ☐

II. Management of Stage I Pure Seminoma of Testes

A. Radiological Investigations

What radiological investigations do you perform as staging work-up for patients who underwent inguinal orchiectomy?

Lymphangiogram	Yes <input type="checkbox"/>	No <input type="checkbox"/>
Chest X-ray	Yes <input type="checkbox"/>	No <input type="checkbox"/>
CT scan of Abdomen & Pelvis	Yes <input type="checkbox"/>	No <input type="checkbox"/>
CT scan of Chest	Yes <input type="checkbox"/>	No <input type="checkbox"/>
Others _____		

B. Management: Stage I pure seminoma of testes

1. In your practice, do you offer the patient the option of surveillance, with salvage radiotherapy or chemotherapy reserved for relapse?

Yes ☐ No ☐

If yes, what proportion of your patients opt for the surveillance? _____ %

2. For patients who wish to preserve fertility, how would you manage Stage I Seminoma of Testes? (Rank 1 to 4, with 1 being "Most Preferable")

Rank

- | | |
|---|--------------------------|
| a) Surveillance with reservation of radiotherapy or chemotherapy for relapse | <input type="checkbox"/> |
| b) Post operative adjuvant radiotherapy to para-aortic region only | <input type="checkbox"/> |
| c) Post-operative adjuvant radiotherapy to para-aortic plus ipsilateral pelvic region | <input type="checkbox"/> |
| d) Post-operative adjuvant single-agent chemotherapy (e.g. one cycle of carboplatin) | <input type="checkbox"/> |

TABLE 1. Questionnaire (cont'd)

3. For patients to whom fertility is not a concern (as they completed family planning), how would you manage Stage I Seminoma of Testes? (Rank 1 to 4, with 1 being "Most Preferable")

	Rank
a) Surveillance with reservation of radiotherapy or chemotherapy for relapse	<input type="checkbox"/>
b) Post operative adjuvant radiotherapy to para-aortic region only	<input type="checkbox"/>
c) Post-operative adjuvant radiotherapy to para-aortic plus ipsilateral pelvic region	<input type="checkbox"/>
d) Post-operative adjuvant single-agent chemotherapy (e.g. one cycle of carboplatin)	<input type="checkbox"/>

C. Post-operative adjuvant radiotherapy for Stage I Seminoma of Testes

1. In this setting, what is your treatment volume? (please choose one)
- | | |
|---|--------------------------|
| a) Para-aortic region only | <input type="checkbox"/> |
| b) Para-aortic region and ipsilateral pelvis (i.e. dog-leg field) | <input type="checkbox"/> |
| c) Others | <input type="checkbox"/> |
2. In this setting, what dose fraction schedule do you use? (please choose one)
(Assumptions: photon ≥ 4 MV; anterior and posterior fields)
- | | |
|--------------------------------------|--------------------------|
| a) 2500 cGy in 20 fractions | <input type="checkbox"/> |
| b) 3000 cGy in 15 fractions | <input type="checkbox"/> |
| c) Others (____cGY in ____fractions) | <input type="checkbox"/> |
3. In 1999, the MRC (Medical Research Council, United Kingdom) Phase III study (JCO, Vol. 17:1146-1154,1999) comparing para-aortic field alone with para-aortic plus ipsilateral pelvic field showed that there was no difference in relapse rate between the two arms. Since this study was published, have you changed your treatment volume from para-aortic plus ipsilateral pelvis to para-aortic only?
- Yes ☐ No ☐
4. If your treatment volume is paraaortic region only, how often do you perform pelvic CT scans to assess pelvic failure after radiotherapy during the first 3 years of follow-up? (please choose one)
- | | |
|-------------------|--------------------------|
| a) annually | <input type="checkbox"/> |
| b) every 6 months | <input type="checkbox"/> |
| c) never | <input type="checkbox"/> |

TABLE 2. Responders by province and country

	Canadian Provinces (n = 73)									United States
Regions	B.C.	Alb.	Sask.	Man.	Ont.	Que.	N.B.	N.S.	N.F.	(n = 24)
# of responders	15	6	5	1	28	8	4	3	3	24

percent included CT scan of chest as routine staging investigation. The proportion of responders performing lymphangiogram and CT scan of chest was greater in the United States than Canada (25% versus 16% and 45% versus 38% respectively).

Management approaches

The prevalence of surveillance in clinical practice was evaluated. Seventy-six (78%) indicated that they would routinely offer surveillance as a management option, while 21 (22%) did not. This rate was not significantly different between Canada and the United States (79% versus 75%). Among the radiation oncologists offering the option of surveillance, the median estimated proportion of patients choosing surveillance was 20% (range: 0% – 100%). This estimate was greater in Canada (median: 25%, range: 0% – 100%) than the United States (median: 7.5%, range: 0% – 50%).

Radiation oncologists were asked to rank, in the order of preference, four management options in the presence or absence of fertility preservation concern. The four management options were: 1) surveillance with reservation of RT or chemotherapy for relapse, 2) post-operative adjuvant RT to the para-aortic region only, 3) post-operative adjuvant RT to the para-aortic plus ipsilateral pelvic region ('dog-leg' field), 4) post-operative adjuvant single-agent chemotherapy. For the management of patients who wished to preserve fertility, two common first choices were option 1 (44%) and 2 (42%). Only 14% chose option 3 as the first choice and none chose option 4. In Canada, the order of management preference was option 1 (56%), 2 (33%), 3 (11%) and 4 (0%). In contrast, the commonest choice in the United States was option 2 (70%). This was followed by option 3 (22%) and option 1 (8%). When fertility preservation was not a major concern to a patient, only 17% chose surveillance as the first choice. Overwhelmingly the responders considered adjuvant RT as the preferable management approach with 43% and 39% favoring option 2 and 3 respectively. None chose adjuvant chemotherapy even in the absence of fertility preservation concern. The order of management preference was option 2 (41%), 3 (37%), and 1 (22%) in Canada, as it was in the United States (option 2: 49%, 3: 47% and 1: 3%).

Post-operative adjuvant radiotherapy for stage I seminoma of testis

In this section, radiation oncologists were asked with respect to dose-fractionation schedule and RT treatment volume. Also evaluated was the impact of the MRC study reporting that relapse-free survival rate

was similar between RT treatment volume limited to the para-aortic region and more traditional 'dog-leg' field although there was a higher risk of pelvic recurrence with the former.⁹

The most prevalent dose-fractionation schedule was 25 Gy in 20 fractions (f) (68%). Other reported schema included 25 Gy/15 f (15%), 25.5 Gy/17 f (4%) and 30 Gy/15 f (2%). In Canada, 73% and 21% chose 25 Gy/20 f and 25 Gy/15 f respectively. In the United States, 25 Gy/20 f was also the commonest regimen (54%) while 25-25.5 Gy/17 f was the second (21%).

Overall, more radiation oncologists used the 'dog-leg' field than the para-aortic field (53% versus 45%). Two (2%) reported to use a modified 'dog-leg' field which covered the para-aortic plus ipsilateral common iliac region. In Canada, the 'dog-leg' field was more prevalent than the para-aortic field (55% versus 42%). In contrast, the 'dog-leg' field was less common than the para-aortic field in the United States (46% versus 54%).

Twenty-eight (29%) reported that they reduced RT treatment volume from the 'dog-leg' field to the para-aortic field as the result of the MRC study. In Canada, 26% gave an affirmative answer, whereas 38% did so in the United States. Sixteen responders indicated that they were using the para-aortic field prior to the publication of the MRC study. They were scored as non-influenced, similar to those indicating no change secondary to the MRC study. Among those radiation oncologists using the para-aortic only field, 41% and 50% would perform CT scan of pelvis annually and every 6 months respectively for 3 years while 9% stated no follow-up CT scan.

Discussion

Overview

Management approach for stage I seminoma of testis is diverse. This diversity is the result of a shift of focus from the usual goal of improving cure to an attempt to minimize the morbidity of treatment, and stems from the fact that management decision is dependant to a considerable extent upon the patient's specific social, emotional and economic circumstances. This survey attempts to evaluate practice patterns of the management of stage I seminoma of testis among radiation oncologists in Canada and, to a limited extent, the United States.

This survey was by no means comprehensive. In our view, overall response rate of 75.2 % was satisfactory and acceptable for analysis. Also the survey very well reflected the practice pattern in Canada as we could identify all radiation oncologists

treating genitourinary tumors by contacting individual provincial regional cancer centers and included them in the survey. However, the survey was very limited in the United States as it targeted only the RTOG genitourinary committee members, although this is a group with established expertise in treating GU malignancies. Another shortfall was that opinions from medical oncologists were not sought in this survey. Due to these limiting factors, together with the fact that most of the responding radiation oncologists (84%) were based at university-affiliated teaching centers, the observed trends or findings of the survey may not be generalizable to the broad radiation oncology community that encompasses those involved with community based or private practice.

Radiological investigations as staging work-up

Almost unanimous agreement was reached among radiation oncologists with regard to the inclusion of chest x-ray and CT scan of abdomen and pelvis as staging work-up. However, there was significant variation for CT scan of chest. Forty percent included CT scan of chest as a part of routine staging investigations while 60% did not. Up to now, there has been no study to evaluate the incidence of positive findings in CT scan of chest for those patients with normal chest x-ray. Thus the benefit of performing CT scan of chest in addition to chest x-ray remains unclear. However, in the three large surveillance studies,⁴⁻⁶ the proportion of patients on surveillance who developed subsequent pulmonary or mediastinal nodal metastasis was very low (<1%). Furthermore, the probability of isolated pulmonary metastasis without relapsing initially in the para-aortic region was even more remote. Therefore, the likelihood of detecting occult pulmonary metastasis on routine CT scan of chest is very small. This suggests that the benefit of performing routine CT scan of chest in addition to chest x-ray would be very marginal. Only 18% would routinely perform bipedal lymphangiogram. This likely reflects the fact that it has been gradually replaced by high-quality abdominal and pelvic imaging such as CT scan over the years and no longer offered in many hospitals.

Management options

It is of interest to note that 22% of responders would not offer the option of surveillance although there has been increasing evidence that surveillance with reservation of RT and/or chemotherapy for salvage of relapse does not compromise cure. There are several potential reasons for reservation regarding

surveillance: 1) surveillance strategy requires a commitment by both the patient and the physician to intensive monitoring, 2) extended follow-up is required, as late relapse is possible, 3) there is concern about potential delay in diagnosing recurrence in poorly compliant patients that may result in a loss of the window of curability, and 4) emotional and economic cost of surveillance can be as costly as up-front adjuvant RT.

There was no significant difference in the proportion of radiation oncologists offering the option of surveillance between Canada and the United States. However, when they were asked to estimate the proportion of patients choosing surveillance in their practice, there was a difference between the two countries. In Canada, radiation oncologists estimated that 20% (median) would opt for surveillance whereas this estimate was only 7.5% in the United States.

One potential drawback pertaining to the surveillance question in this survey is that it did not specify risk factors for relapse such as the size of the primary tumor and the invasion into the rete testis. An estimated risk of relapse based on pathological features in an individual patient would certainly influence a clinician's as well as patient's inclination towards surveillance strategy.

Whether or not there was concern for the preservation of fertility influenced management choice. When there was no fertility preservation concern, the majority (82%) recommended adjuvant RT, although responders were divided with respect to RT treatment volume. Surveillance was recommended by only 18%. In contrast, when there was fertility preservation concern, the choice of surveillance became as popular as adjuvant RT limited to the para-aortic region (44% versus 42%). Fewer responders chose the traditional 'dog-leg' field as their first choice (13%). In the United States, adjuvant RT limited to the para-aortic region remained the preferred choice even in the presence of fertility preservation concern.

Post-operative adjuvant RT

There has been a trend towards using a smaller RT volume, partly based on the published MRC study. Twenty-eight (29%) reported that RT treatment volume was reduced to the para-aortic field from the 'dog-leg' field in their practice as the result of the MRC study. However, radiation oncologists remained, in general, evenly divided between the traditional 'dog-leg' field and the para-aortic field (53% versus 45%). There are two potential reasons for the continued use of the 'dog-leg' field. Firstly, in the MRC study the para-aortic

only field was associated with a higher risk of pelvic relapse compared to the 'dog-leg' field although the absolute magnitude of the increase was small. This implies that patients treated only to the para-aortic region require continuous close monitoring with CT scan of pelvis even after adjuvant RT. Secondly, the added morbidity of the 'dog-leg' field could be considered relatively minimal compared to that from the para-aortic field. Although the MRC study showed that the acute side effects of RT such as nausea, diarrhea, and leukopenia were less frequent and less pronounced with the para-aortic field, there was no difference in long-term toxicity including the incidence of second malignancy and peptic ulcer between the two treatment volumes.⁹ Moreover, the benefit of 'spermatogenesis-saving' effect of the reduced para-aortic field diminished with longer follow-up.⁹ The MRC study reported that an estimated 92% of patients treated with the 'dog-leg' field were able to attain a sperm count of at least 10×10^6 /ml at 3 years from the start of RT.

There appears to be selective adaptation of the MRC study protocol to clinical practice. While 29% of the responders reduced RT treatment volume to the para-aortic field following the MRC study, almost none changed their dose fractionation schedule. Only 2% used 30 Gy/15 f, which was the dose-fractionation schedule used in the MRC study. The most likely explanation would be that there was no compelling reason to change a dose-fractionation schedule since less intensive dose-fractionation schedules such as 25 Gy/20 f were sufficient enough to provide excellent tumor control, reported by retrospective series. There was also no clear indication that radiation oncologists followed the MRC study protocol with respect to the frequency of follow-up CT scan of abdomen and pelvis after RT. In the MRC study, patients were followed with CT scan of abdomen and pelvis annually during the first 3 years following RT, which helped to detect pelvic relapses. In this survey, 9% of radiation oncologists using the para-aortic field indicated no follow-up CT scan of pelvis, while 41% and 50% would perform CT scan of pelvis annually and every 6 months respectively for 3 years. Thus, there is need to develop a guideline or consensus for the frequency of follow-up CT scan of pelvis following adjuvant RT limited to the para-aortic region.

There is significant variation in dose-fractionation schedule among radiation oncologists. The majority used 25 Gy/20 f. Other schema included 25 Gy/15 f and 25-25.5 Gy/17 f. Development of a dose-fractionation schedule that minimizes toxicity, but continues to cure virtually all patients and conforms

to the social and lifestyle constraints of individual patients remains the challenge of ongoing clinical research.

Conclusion

Significant variation remains in the management of stage I seminoma of testis among radiation oncologists in Canada and a selected group in the United States. In particular, there is diversity with respect to the extent of the use of surveillance, RT treatment volume and dose-fractionation schedule. The presence or absence of fertility preservation concern significantly influences the choices of surveillance and RT treatment volume. Although there has been a trend towards using the para-aortic field based on, in part, the MRC study, about half of responders continue to use the traditional 'dog-leg' field. The outcome of this survey can be a useful basis for a future study that explores further refinement of the management of stage I seminoma of testis. □

References

1. Fossa SD, Aass N, Kaalhus O. Radiotherapy for testicular seminoma stage I: treatment results and long-term post-irradiation morbidity in 365 patients. *Int J Radiat Oncol Biol Phys* 1989;16:383-388.
2. Dosmann MA, Zagars GK. Post-orchietomy radiotherapy for stages I and II testicular seminoma. *Int J Radiat Oncol Biol Phys* 1993;26:381-390.
3. Warde P, Gospodarowicz MK, Panzarella T, et al. Stage I testicular seminoma: results of adjuvant irradiation and surveillance. *J Clin Oncol* 1995;13:2255-2262.
4. Warde P, Gospodarowicz MK, Banerjee D, et al. Prognostic factors for relapse in stage I testicular seminoma treated with surveillance. *J Urol* 1997;157:1705-1710.
5. von der Maase H, Specht L, Jacobsen GK, et al. Surveillance following orchidectomy for stage I testicular seminoma of the testis. *Eur J Cancer* 1993;29A:1931-1934.
6. Horwich A, Alsanjari N, A'Hern R, et al. Surveillance following orchidectomy for stage I testicular seminoma. *Br J Cancer* 1992;65:775-778.
7. Kiricuta IC, Sauer J, Bohndorf W. Omission of the pelvic irradiation in stage I testicular seminoma: A study of postorchietomy paraaortic radiotherapy. *Int J Radiat Oncol Biol Phys* 1996;35:293-298.
8. Sultanem K, Souhami L, Benk V, et al. Para-aortic irradiation only appears to be adequate treatment for patients with stage I seminoma of the testis. *Int J Radiat Oncol Biol Phys* 1998;40:455-459.
9. Fossa SD, Horwich A, Russell JM, et al. Optimal planning target volume for stage I testicular seminoma: a Medical Research Council randomized trial. *J Clin Oncol* 1999;17:1146-1154.
10. Oliver RT, Edmonds PM, Ong JY, et al. Pilot studies of 2 and 1 course carboplatin as adjuvant for stage I seminoma: should it be tested in a randomized trial against radiotherapy? *Int J Radiat Oncol Biol Phys* 1994;29:3-8.
11. Dieckmann KP, Krain J, Kuster J, et al. Adjuvant carboplatin treatment for seminoma clinical stage I. *J Cancer Res Clin Oncol* 1996;122:63-66.
12. Dieckmann KP, Bruggeboes B, Pichlmeier U, et al. Adjuvant treatment of clinical stage I seminoma: is a single course of carboplatin sufficient? *Urology* 2000;55:102-106.