Does Institutional Patient Accrual Volume Impact Overall Survival in Patients with Inoperable Non-Small-Cell Lung Cancer Receiving Radical (Chemo)Radiation? A secondary analysis of TROG 99.05.

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This is the author manuscript accepted for publication and has undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the [Version of Record](#). Please cite this article as [doi: 10.1111/1754-9485.13042](https://doi.org/10.1111/1754-9485.13042)

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Article type : Radiation Oncology Original Article

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Abstract

Introduction: Increased hospital patient volume, reflecting greater experience, has been shown to be associated with improved survival for some cancers. However, there is no evidence to support the volume-outcome hypothesis for inoperable non-small-cell lung cancer (NSCLC) patients within the Australasian setting. We examined the relationship between overall survival (OS) and institutional patient accrual volume (IPAV) in a large prospective Australasian NSCLC database (TROG 99.05).

Methods: TROG 99.05 was an observational study which accrued patients from 1999 to 2007 to examine the relationship between primary lung cancer volume and survival. To be eligible for inclusion, patients had to have inoperable, biopsy-proven NSCLC planned for radiotherapy to a minimum dose of 50Gy in 20 fractions, with or without chemotherapy. Participating institutions were de-identified and grouped according to whether accrual was low, medium or high. OS was compared between groups, and adjusted for prognostic factors using Cox regression.

Results: 509 patients were accrued from 16 centres. Median potential follow-up time was 60 months. Median survival for all groups was 20 months (95% CI 18.3-21.8 months). There were no statistically

significant differences in OS with increasing patient accrual across the three groups after adjustment for prognostic factors ($p=0.84$, 2 df). The hazard ratios (HR) for group accrual volumes, relative to that for high accrual volume, were: low, 1.18; medium, 1.14. Test for trend: HR=0.91 per group (95% CI 0.76-1.09, $p=0.31$).

Conclusion: In the setting of a clinical trial with rigorous quality assurance, we found no evidence for an association between institutional accrual and survival.

Keywords: patient volume, institutional accrual, survival, radiotherapy, non-small-cell lung cancer

1 Introduction

2 Lung cancer remains one of the most common cancers diagnosed in
3 Australia in 2019, with an estimate of 8.9% of all new cancer cases
4 diagnosed, contributing to 18% of all deaths from cancer. 7,149 patients
5 were diagnosed with lung cancer in Australia in 1990, and it has risen to
6 12,817 in 2019. From 2011-2015, lung cancer patients had a 17% chance
7 of surviving at least 5 years, which has almost doubled, compared with
8 9.2% 25 years before that.¹ Surgery was traditionally believed to be the
9 only treatment capable of prolonging survival in patients with NSCLC in the
10 past,² however for many patients surgery is not possible because of
11 unfitness due to comorbidities or, in locally advanced disease, technical
12 unresectability, or both. For these patients radical radiotherapy with or
13 without cisplatin-based chemotherapy may be an alternative potentially
14 curative option.³ 30-60% of patients with stage I-III disease were expected
15 to receive radical radiotherapy.

16 Overall survival and treatment outcomes of cancer patients have been
17 reported to be superior for hospitals with greater institutional experience.⁴⁻
18 ¹² This has been shown in patients having surgery for lung cancer.^{5,6} Some
19 radiation oncology studies have previously demonstrated that institutional
20 experience substantially influences the survival in radical treatment of head
21 and neck, lung and gynaecological cancers.⁷⁻¹²

22 In multiple published studies investigating this relationship in non-
23 small-cell lung cancer (NSCLC), overall survival was longer in patients
24 treated in high volume facilities,¹⁰ or in patients treated in centres with
25 higher clinical trial institutional patient accrual volume (IPAV), which was
26 used as a surrogate for institutional experience.^{7,12} However, it is not clear
27 if this reflects publication bias, and there is no evidence to support the
28 volume-outcome hypothesis in the Australasian setting.

30 Methods

31 This is an unplanned, secondary analysis of the Trans-Tasman
32 Radiation Oncology Group (TROG) 99.05 study data. This study was

approved by the ethics committee of our institution, with permission from TROG to use the data from the TROG 99.05 study. TROG 99.05 was a multicentre, prospective observational study, which was primarily designed to examine the relationship between tumour volume and survival in patients with non-small-cell lung cancer, treated with radical radiotherapy, with or without chemotherapy.¹³ The patients were recruited between September 1999 and July 2007.

Patients and treatment

As per the TROG 99.05 protocol, patients recruited to the study were required to have histological or cytological diagnosis of NSCLC, along with a staging CT scan of the chest and upper abdomen. Staging FDG PET scan was optional. These patients had to be stage I-IIIB (6th edition TNM Staging), but supraclavicular lymph node involvement or pleural effusion was excluded.¹³

At least 3D conformal radiotherapy planning was used with radical dose of 60Gy in 6 weeks, or 50Gy in 4 weeks, or any other biologically equivalent doses to that. Individual fraction size was 2.5Gy maximum. Tumour and lymph node delineation was performed by the radiation oncologist as per the contouring protocol provided, with mandatory independent contouring by a diagnostic radiologist as well as strict contouring quality assurance procedures.¹³ In addition, the first five contoured volumes of each participating institutions were reviewed by the principal investigator (single radiation oncologist), and this was requested to be repeated should it fail to meet requirements. Random audits of the volumes were also conducted subsequently.

Statistical Methods

The primary hypothesis of this study was to test that higher IPAV is associated with better survival outcomes in patients receiving definitive radiotherapy for NSCLC, with the primary endpoint being the overall survival of patients, measured from date of registration to date of death,

no matter the cause.

Participating institutions were de-identified. The IPAV, which is the total accrual number achieved by each individual participating institution in the TROG 99.05 study, ranged from 2 to 214 patients per institution. Accrual by institution is shown in Fig. 1. Institutions were divided into 3 groups: low (consisting of 2 to 12 patients per institution), medium (29 to 64 patients), and high (214 patients in a single institution). The number of groups and their definitions were decided *a priori* on the basis of equalising, as far as possible, the number per group and 'natural' grouping boundaries.

Overall survival (OS) was measured from registration and displayed as Kaplan-Meier plots.

The pre-planned primary analysis compared survival between the three groups, before and after adjustment for prognostic factors, using Cox multivariable regression. These prognostic factors, which were identified in a multivariable analysis in the previous TROG 99.05 study, were nodal status, sex, planned chemotherapy, ECOG performance status and T stage. Age, weight loss, and tumour volume were the other variables considered but were not significant predictors after allowing for these variables.¹³ Secondary analyses involved the different IPAV groups, and the total accrual number per institution.

Results

There were 509 patients from 16 centres in Australia and New Zealand available for analysis.¹³ Baseline characteristics of the patients by IPAV groups are given in Table 1. Figure 2 demonstrates the timing of patient registrations for each participating institution throughout the trial accrual period.

The median potential follow-up time was 60 months. 14 patients were lost to follow-up. There were 385 patients who have died. The cause of death of 80% of these patients was cancer- or treatment-related. 76% of patients received a bioequivalent dose of 60Gy. 62% of patients received concomitant chemotherapy. The 5-year overall survival of the whole cohort,

was 18% (95% CI = 14% to 22%). Median survival was 20 months.¹³

The median survival times by IPAV group were 18.8 months for the low accrual group, 21.1 months for the medium accrual group and 19.7 months for the high accrual group, with no overall significant difference (Fig. 3a; $p(\text{trend}) = 0.73$, $\text{HR} = 0.97$, 95% CI = (0.84, 1.32); $p(2 \text{ df})=0.84$). The hazard ratios for group accrual volumes, relative to that for the high IPAV group, were 1.18 for low and 1.14 for the medium IPAV group. After adjustment for the previously identified prognostic factors, there was still no difference in survival between the three IPAV groups (Table 2, Fig. 3b; $p(\text{trend}) = 0.31$, $\text{HR} = 0.91$, 95% CI = (0.76, 1.09); $p(2 \text{ df})=0.56$).

Secondary analyses were performed on seven IPAV groups, with all the low accruing institutions in one group and the remaining six institutions ungrouped. Multivariable analyses still showed no evidence for a trend in increasing survival with increasing volume of accrual among the seven institution groups, after adjusting for the five prognostic factors ($p_{\text{trend}}=0.87$). Overall adjusted test between the seven groups was not statistically significant ($p=0.40$, 6 df).

Discussion

This study did not show an association between IPAV and survival in contrast to most other reports.^{7,10,12} Although the p-value for adjusted trend in IPAV groups was not significant, the associated confidence interval contains trends that may be of clinical importance so we may not have demonstrated that there is no important such trend in our setting. Eaton et al. reported statistically significant longer median overall survival of 26.2 months in high volume centres, compared with 19.8 months in low volume centres.¹² Lee et al. reported median survivals of 20.5 and 13.4 months respectively in institutions enrolling 5 or more and institutions enrolling less than 5 patients, with a statistically significant difference.⁷ Wang et al. reported median survival rates of 19.7 months in high volume facilities and 17.3 months in low volume facilities.¹⁰ There is however, an abstract

published by Damhuis et al. from Netherlands showing results similar to ours, when they assessed the association between facility case volumes and survival from the annual treatment volume from the Netherlands National Cancer Registry.¹⁴ Although, they assessed patients with stage III disease only, who were treated from a later time period.

Table 3 provides a summary of differences in details between our study and the different studies assessing institutional volume and survival outcome in NSCLC. The classification of a low and high volume centre in these studies vary from ours, hence their results may not necessarily be comparable to ours. We chose our cutoffs according to Fig. 1 over a period of almost 8 years. Their accrual period and patient numbers differ from ours. Eaton et al. used 3 patients as a cutoff for a low volume centre due to the narrow range of patient accrual for institutions of that study. Their high volume centres recruited 4 to 18 patients, and was over a period of 4 years.¹² Lee et al. used 5 as a cutoff, which was “empirically” selected. The patient accrual was from 2 studies which recruited over a period of 1 to 2 years.⁷ Wang et al. however, utilized data from the National Cancer Database and they classified high-volume facilities as those in the ninetieth percentile of annual definitive concurrent chemoradiation volume (≥ 12 cases/year).¹⁰

The determinations of the cutoff between a high and low volume centre are often arbitrary and make comparisons between studies difficult. This is further complicated by the different group definitions, and the number of groups defined. The institutional rate of accrual of eligible patients is the ideal measure to use in such studies. However, it may not accurately represent this measure: an institution may contribute only a proportion of its eligible patients or may participate in the study for only part of the total trial period.

A limitation of our study is that patient accrual was used as a surrogate rather than actual institutional volume itself. The number of patients accrued to a trial are not necessarily representative of the overall number of patients treated or institutional experience. For example, some of our

large volume institutions have participated late in the trial and did not accrue for the whole length of the trial accrual period, thus contributed only a small number of cases (Fig. 2).

The majority of our centers in our study prescribed 60Gy, which is delivered over a period of 6 weeks, and the next commonest dose prescribed is 50Gy, which is likely to be delivered over a period of 4 weeks. Dose escalation beyond 60Gy was noted only in the low and medium IPAV groups. There is more variability in dose prescription in the medium IPAV group. Unfortunately, in our study we are not able to calculate the biological dose equivalence between the different groups as the duration of treatment and fraction size were not recorded.

Contouring quality assurance measures of the original TROG 99.05 study were fairly rigorous. With the assistance of a protocol for guidance and mandatory radiologist input, only 24% of initial volumes of participating institutions reviewed by the principal investigator were found to require re-contouring, and only 2 of the 17 volumes which were subsequently audited required re-contouring. From the study reported by Eaton et al., quality assurance of target definition was also performed by the principal investigators. In terms of treatment compliance, there was significant variation in the techniques used, oesophageal and heart doses received, and acceptable organ at risk tolerances, when comparing between low and high-volume centres. Updated techniques were also used in the process of target volume delineation and planning in this study, as opposed to our study which commenced recruiting 20 years ago, and in which dose constraints to organs at risk were not specified.¹² The quality assurance measures in the studies analysed by Lee et al. however, were not clearly stated.⁷

We considered the technological differences in practices amongst the institutions as well. There is little high level evidence that new technology improves survival. Although our study was based on practices 10 to 20 years ago, at least 3D-CRT was mandated.¹³ With Eaton et al. reporting worse survival in less-experienced institutions, Chun et al. commented that

low-volume centres were more likely to use 3D conformal radiotherapy (3D-CRT) in that study. However, Chun et al. also reported that there was no significant difference found in the 2-year overall survival, progression-free survival, local failure and distant metastasis-free survival when comparing between intensity-modulated radiation therapy (IMRT) and 3D-CRT.¹⁵ Harris et al. also reported similar overall survival and cancer-specific survival comparing both techniques after adjusting for confounding factors.¹⁶ Hence, we do not believe that IMRT use would have provided superior survival outcomes, however the safety of IMRT use in low-volume centres is uncertain. In terms of use of image guided radiotherapy, Batumalai et al. performed a survey of its use in Australia and found that there is considerable variation in image guidance and verification practices nationwide in 2015, which may result in another variable influencing the outcome, however there have been no studies reporting on the association between image guidance techniques and its impact on clinical outcomes yet.¹⁷

It is almost axiomatic that institutions with less experience in treating complex medical problems will have worse outcomes than those treating higher volumes when treating patients of similar prognosis. Studies which reinforce this widely accepted belief may be more likely to be accepted for publication. Most publications we could find in relation to radical radiotherapy for lung cancer all supported the accrual volume-outcome hypothesis. If the accrual volume is a prognostic factor, does it mean that small volume centres should be excluded from participation in clinical trials? Reassuringly, our analysis indicates that in Australia and New Zealand, if patients are treated according to a trial protocol with peer review of the contouring in a collaborative group setting, the number of patients accrued does not appear to affect survival. The success of the contouring QA procedures of this trial minimized variations of practice that could potentially impact survival between small and large recruiters. Thus the implication for future research can be that clinical trial activity can safely be encouraged in small centres, typically regional, rural or private and not

225 just reserved for large academic metropolitan centres.

References

- 1 Canceraustralia.org. Lung cancer statistics. [updated 2019 Aug 26; cited 2020 Mar 16]. Available from: <https://lung-cancer.canceraustralia.gov.au/statistics>.
- 2 Mountain CF. Revisions in the international system for staging lung cancer. *Chest* 1997; **111**: 1710-17.
- 3 Aupérin A, Le Péchoux C, Rolland E *et al*. Meta-analysis of concomitant versus sequential radiochemotherapy in locally advanced non-small-cell lung cancer. *J Clin Oncol* 2010; **28**: 2181-2190.
- 4 Hillner BE, Smith TJ, Desch CE. Hospital and physician volume or specialization and outcomes in cancer treatment: importance of quality of cancer care. *J Clin Oncol* 2000; **18(11)**: 2327-2340.
- 5 Bach PB, Cramer LD, Schrag D, Downey RJ, Gelfand SE, Begg CB. The influence of hospital volume on survival after resection for lung cancer. *N Engl J Med* 2001; **345(3)**: 181-188.
- 6 Silvestri GA, Handy J, Lackland D, Corley E, Reed CE. Specialists achieve better outcomes than generalists for lung cancer surgery. *Chest* 1998; **114(3)**: 675-680.
- 7 Lee JS, Scott CB, Komaki R, Ettinger DS, Sause WT. Impact of institutional experience on survival outcome of patients undergoing combined chemoradiation therapy for inoperable non-small-cell lung cancer. *Int J Radiation Oncology Biol Phys* 2002; **52(2)**: 362-370.
- 8 Chen AY, Fedewa S, Pavluck A, Ward E. Improved survival is associated with treatment at high-volume teaching facilities for patients with advanced stage laryngeal cancer. *Cancer* 2010; **116**: 4744-52.
- 9 Lin JF, Berger JL, Krivak TC *et al*. Impact of facility volume on therapy and survival for locally advanced cervical cancer. *Gynecologic Oncology* 2014; **132**: 416-422.

10 Wang EH, Rutter CE, Corso CD *et al.* Patients selected for definitive concurrent chemoradiation at high-volume facilities achieve improved survival in stage III non-small-cell lung cancer. *J Thorac Oncol* 2015; **10(6)**: 937-943.

11 Wuthrick EJ, Zhang Q, Machtay M *et al.* Institutional Clinical Trial Accrual Volume and Survival of Patients with Head and Neck Cancer. *J Clin Oncol* 2015; **33**: 156-164.

12 Eaton BR, Pugh SL, Bradley JD *et al.* Institutional enrollment and survival among NSCLC patients receiving chemoradiation: NRG Oncology Radiation Therapy Oncology Group (RTOG) 0617. *J Natl Cancer Inst* 2016; **108(9)**: 1-8.

13 Ball DL, Fisher RJ, Burmeister BH *et al.* The complex relationship between lung tumor volume and survival in patients with non-small cell lung cancer treated by definitive radiotherapy: A prospective, observational prognostic factor study of the Trans-Tasman Radiation Oncology Group (TROG 99.05). *Radiother Oncol* 2013; **106**: 305-311.

14 Damhuis R, Walraven I, Widder J, Senan S, Belderbox J. Facility case volume and survival in patients with stage III non-small cell lung cancer treated with chemoradiotherapy. *Eur J Cancer* 2015; **51**: S596.

15 Chun S, Hu C, Choy H *et al.* Impact of intensity-modulated radiation therapy technique for locally advanced non-small-cell lung cancer: A secondary analysis of the NRG Oncology RTOG 0617 randomized clinical trial. *J Clin Oncol* 2017; **35**: 56-62.

16 Harris J, Murphy J, Hanlon A, Le Q, Loo B, Diehn M. A population-based comparative effectiveness study of radiation therapy techniques in stage III non-small cell lung cancer. *Int J Radiation Oncology Biol Phys* 2014; **88(4)**: 872-844.

17 Batumalai V, Holloway L, Kumar S *et al.* Survey of image-guided radiotherapy use in Australia. *J Med Imaging Radiat Oncol* 2017; **61**:

394-401.

Tables**Table 1. Baseline characteristics by IPAV Group**

Percentages within the table are column percent (with accuracy to the nearest percent, or tenth of a percent if less than 10%)

Factor	Total	Low (12%)	Medium (46%)	High (42%)	p-value (1 df)*
All patients	509	59	236	214	
N positivity					
Neg	259 (51%)	39 (66%)	145 (61%)	75 (35%)	<0.001
Pos	250 (49%)	20 (34%)	91 (39%)	139 (65%)	
Sex					
Male	349 (69%)	37 (63%)	165 (70%)	147 (69%)	0.59
Female	160 (31%)	22 (37%)	71 (30%)	67 (31%)	
Planned chemotherapy					
No	187 (37%)	37 (63%)	137 (58%)	13 (6.1%)	<0.001
Yes	322 (63%)	22 (37%)	99 (42%)	201 (94%)	

ECOG PS

0	151 (30%)	22 (37%)	91 (39%)	38 (18%)	<0.001
1	303 (60%)	35 (59%)	124 (53%)	144 (67%)	
2	52 (10%)	2 (3.4%)	20 (8.5%)	30 (14%)	
3	2 (0.4%)	0 (0.0%)	1 (0.4%)	1 (0.5%)	
Miss.	1	0	0	1	

T Stage

1	64 (13%)	8 (14%)	43 (18%)	13 (6.1%)	0.002
2	248 (49%)	30 (51%)	110 (47%)	108 (50%)	
3	101 (20%)	13 (22%)	50 (21%)	38 (18%)	
4	96 (19%)	8 (14%)	33 (14%)	55 (26%)	

Prescribed Total**Dose (Gy)**

50	57 (11%)	21 (36%)	34 (14%)	2 (0.9%)	<0.001
50.6-58.5	14 (2.8%)	1 (1.7%)	13 (5.5%)	0 (0%)	
60	389 (76%)	27 (46%)	150 (64%)	212 (99%)	
60.4-72.8	49 (10%)	10 (17%)	39 (17%)	0 (0%)	

Median Tumour**Volume (cc)**

Median	48.0	38.6	34.4	65.9	<0.001
(%≥48.0)		(44%)	(41%)	(62%)	

Table 2. Cox multivariable regression results testing for trend in OS for IPAV groups, adjusting for prognostic factors

Variable	Hazard Ratio	95% CI	2P
IPAVG (as ordered variable, 0:2)	0.91	0.76 to 1.09	0.31
Node positivity (0:1)	1.52	1.22 to 1.91	<0.001
Sex (M:F)	1.42	1.13 to 1.79	0.003
Planned chemotherapy	0.76	0.58 to 0.98	0.038
ECOG performance status (0:3)	1.26	1.007 to 1.47	0.005
T stage (1:4)	1.13	1.01 to 1.26	0.034

Table 3. Comparison with other studies assessing institutional volume association with overall survival

Author/Study Group	Data source, Years/average follow-up (FU)	Accrual or institutional volume	Numbers and groupings (ranges)	Primary aim/analysis	QA done	Conclusion
Tan et al./TROG 99.05	TROG Prospective observational, 1999-2007,	Accrual	N=509, 16 centres Three groups:	Impact of institutional accrual volume on OS	Rigorous	No evidence for relationship of OS to accrual volume

	Average FU = 60 months		(2-12, 29- 64, 214)			
Eaton et al./RTOG 06- 17	RTOG Randomised trial, 2007-2011, Average FU = 22.9 months	Accrual	N=495, 180 institution s Two groups: (1-3, 4-18)	Impact of institution al accrual volume on OS	Rigorou s	Higher accrual volume associate d with longer OS
Lee et al./RTOG 91- 06 & RTOG 92-04	Two RTOG phase II trials RTOG 91- 06: 1991- 1992, FU = 21-30 months RTOG 92- 04: 1992-1994, Minimum FU = 20 months	Accrual	RTOG 91- 06: N=76 Multicent er RTOG 92- 04: N=163 Multi- institution al Two groups: (<5 , ≥ 5)	Impact of institution al volume on survival rates	Uncerta in	Institution al experien ce has significant impact on survival outcome
Wang et al./National Cancer Data Base	National Cancer Data Base 2004-2006	Institution al volume	N=10,072 Multicent er	Impact of facility case	N/A	High volume facilities associate

			Two groups: (<12 or ≥12 cases/year (90 th percentile of annual RT volume))	volume on OS		d with improved OS.
Damhuis et al./Netherlands National Cancer Registry	Netherlands National Cancer Registry 2010-2013	Institutional volume	N=3802, Multicenter Three groups: (<24, 24-47, ≥48 cases/year)	Association between facility case volume and OS	N/A	No association between facility case volume and OS.

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Title:

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Date:

2020-05-11

Citation:

Tan, M. Y., Fisher, R. & Ball, D. (2020). Does institutional patient accrual volume impact overall survival in patients with inoperable non-small-cell lung cancer receiving radical (chemo)radiation? A secondary analysis of TROG 99.05. JOURNAL OF MEDICAL IMAGING AND RADIATION ONCOLOGY, 64 (4), pp.556-562. <https://doi.org/10.1111/1754-9485.13042>.

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