



Impact of Radiation Source Activity On Short-Term Outcomes of Cervical Carcinoma Patients Treated with Brachytherapy: A Propensity Score Based Analysis

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INTRODUCTION

Cervical carcinoma (CC) is the fourth most common cancer diagnosed in women worldwide, near 85% of which occurred in low- and middle-income countries, causing considerable social and economic burdens¹. As a critical component of definitive radiation therapy for CC, high-dose-rate (HDR) brachytherapy provides dose boost to the cervix, which improves local control probabilities and overall survival rates significantly².

Iridium-192 is broadly used for HDR afterloading brachytherapy, which has relatively short half-life of ~74 days. Delayed source replacement is very common in clinics due to many possible reasons, which causes large varieties of dose rate in treatment delivery. However, it is unknown if there is a potential biological impact of lower source activity on patient short-term outcomes, within the dose-rate scope of HDR modality (>12Gy/h)³, which might be different from that of LDR. These missing evidences are needed to support more informed clinical decisions, financial optimization and environmental conservation by reducing radioactive-waste disposal⁴.

AIM

High-dose-rate (HDR) afterloading brachytherapy using Iridium-192 source involves large radiation activity varieties due to fast decay. It was unknown but clinically desirable to evaluate its impacts on patient outcomes to support more informed decisions.

METHOD

This retrospective analysis was performed on 700 CC patients treated with HDR afterloading brachytherapy using 192Ir source, 104 of which experienced a source change (SC group) during their treatment course. The remaining patients were divided into high activity (HA, n=190) and low activity (LA, n=406) groups according to their mean dose rate of all fractions (19/30/361/254/35/1 patients received 2/3/4/5/6/7 fractions respectively). The cutoff was set as the average of the maximum and minimum air kerma strength, i.e. 25403.4 cGy*cm²/h. The 1-month and 3-month follow-up results were marked by complete response (CR), partial response (PR), stable disease (SD), and progressive disease (PD), per response evaluation criteria in solid tumors 1.1. To reduce patient selection bias, pairs of propensity-score-matched (PSM) were generated based on clinical information. Results were compared using Pearson's Chi-squared test.

RESULTS

Amongst SC, HA and LA groups, short-term follow-up results showed no significant difference ($P>0.05$). The CR/PR/SD/PD results and the corresponding p-values were 73-85/74-59/1-4/0-0 for HA-LA 1-month, $p=0.111$; 120-128/26-17/0-2/2-0 for HA-LA 3-month, $p=0.105$; 32-43/45-36/4-2/0-0 for SC-No SC (HA and LA) 1-month, $p=0.194$; and 66-66/13-13/0-1/2-0 for SC-No SC 3-month, $p=0.393$ respectively.

The Air-kerma-strength varieties of brachytherapy sources in each treatment can be observed in **figure 1**

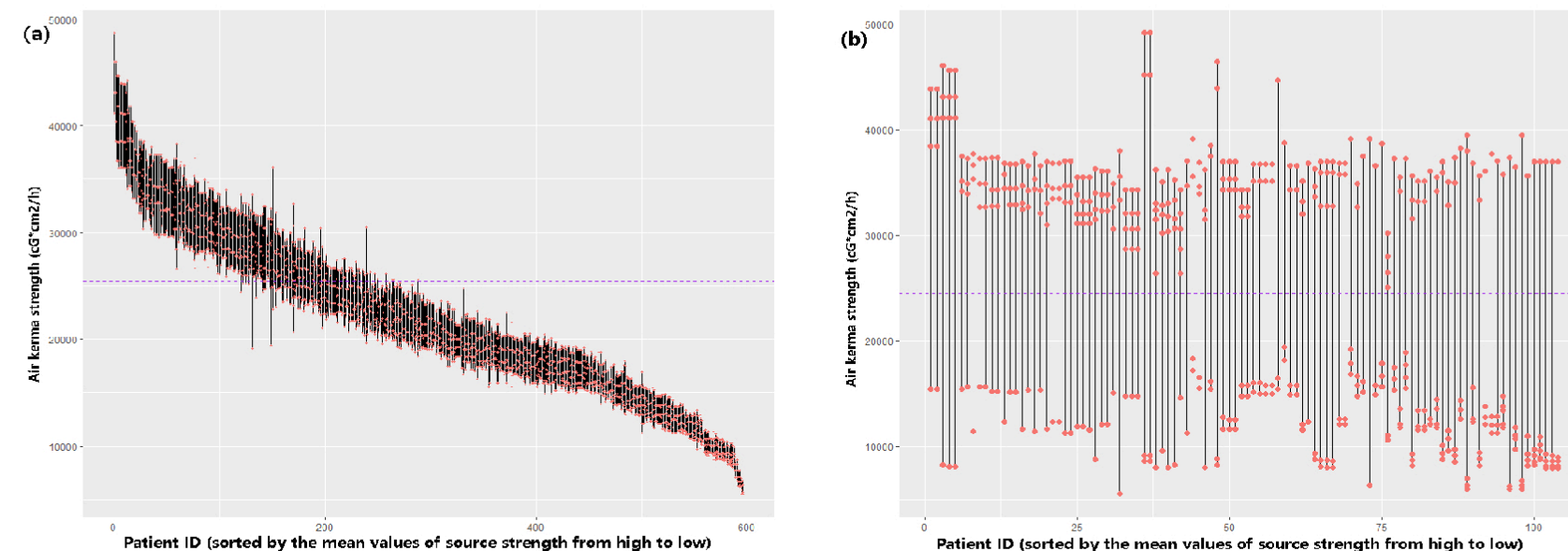


Figure 1 Air kerma strength of brachytherapy sources in each treatment (red points represent a treatment, lines represent a patient, purple lines in two figures represent the boundaries between high activity group (HA) and low activity group (LA). (a) Patients treated with one source throughout the course; (b) Patients experienced source change (SC) during the treatment course.



CONCLUSIONS

This preliminary PSM study observed no significant impact of radiation source activity on biological effects in terms of short-term outcomes of cervical carcinoma patients treated with brachytherapy. Studies based on larger patient volume and long-term follow-up surveys are being performed.

Key words: radiation source activity; brachytherapy, Ir-192 source

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