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14. ABSTRACT The role of B cells in the tumor progression is not fully understood. Recent studies have suggested that specifically in prostate cancer, B cells promote inflammation that causes faster progression towards castrate resistant prostate cancer, which is difficult to treat. We tested the immune effects of depleting B cells using an anti CD20 antibody in conjunction with castration, which is commonly used as neo-adjuvant therapy for radiation. CD20 depletion leads a shift in the tumor environment with an increase in CD8+ T cells. Both CD4+ and CD8+ T cells are more responsive to TCR stimulation. However, survival is not enhanced with CD20 depletion.					
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Introduction

Background and Rationale:

Although local therapy is initially efficacious, up to 50% of prostate cancer (CaP) patients develop recurrent disease (1). Androgen deprivation therapy (ADT) in the neo-adjuvant setting is utilized primarily to reduce tumor burden, decreased tumor hypoxia, and increased apoptosis of the tumor. Additionally, ADT prompts leukocytes to migrate into the regressing tumors. The migration of CD4+ T cells may be beneficial for tumor progression (2-4). If those CD4+ T cells are of the Th1 subset and can directly lyse tumor cells or provide help to cytolytic CD8+ T cells. The cytokine milieu within the tumor microenvironment plays an important role in dictating the tumor response. Ammirante et al. identified tumor infiltrating B cells as key mediators of androgen resistance and tumor progression through production of the lymphotoxin alpha in a mouse model of prostate cancer (5).

Tumor infiltrating B cells have been directly implicated in promoting CaP progression by the production of inflammatory cytokines (6). An early intervention that improves the response to androgen deprivation may be key in preventing CaP progression. A study in colon cancer indicated that depletion of B cells augmented anti-tumor responses and could suppress metastasis (7). However, this is likely tumor type specific as other researchers have found that the absence of B cells impacts the reactivity of CD4+ and CD8+ T cells to tumors (8). Better understanding of the deleterious role of B cells and the possible efficacy of B cell depletion at the time of castration warrants further study for the treatment of prostate cancer.

Patient Humoral Responses and Associated Outcomes:

Investigators at the Deeley Research Centre have previously shown that standard treatments for prostate cancer, in particular ADT and radiation therapy (RT), trigger tumor-specific immune responses as measured by the presence of antibodies that recognize self-antigens (autoantibodies). Specifically, pre- and post-treatment serum from 73 prostate cancer patients was evaluated by Western blot and SEREX (serological identification of antigens by recombinant cDNA expression cloning) antigen arrays for the appearance of treatment-associated autoantibody responses(9). We observed the emergence of autoantibody responses in patients undergoing neoadjuvant ADT (7 of 24, 29.2%), EBRT (5 of 29, 17.2%) and brachytherapy (5 of 20, 25%). In contrast, responses were not seen in patients undergoing surgery (0 of 14) or watchful waiting (0 of 9) (9). Therefore, the tumor specific immune responses were only observed in patients that received ADT and RT.

The clinical status of these patients has now been followed past 5 years (median 73 months). We found that patients who developed autoantibody responses to tumor antigens were more likely to experience biochemical failure (Figure 1, $p=0.025$, HR=5.99, 1.25-28.75 95% CI). The detection of treatment-induced autoantibodies (made by B cells) suggests that a CD4+ T cell response is also elicited by treatment. CD4+ T cells, termed helper cells, assist B cell and cytolytic CD8+ T cell function. This help is essential for the long-term function and maintenance of CD8+ T cells, which are able to directly kill tumor cells (10). Thus, CD4+ T cells play an essential role in both humoral and adaptive immunity, but are frequently overlooked in immunotherapies in favour of eliciting a response from tumor-specific CD8+ T cell responses.

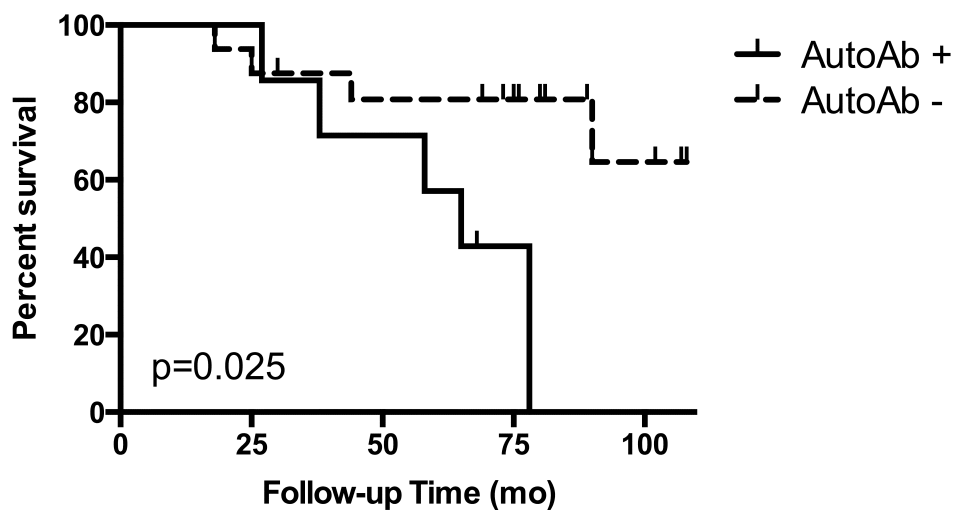


Figure 1. Prostate cancer recurrence in patients treated with ADT and External Beam Radiation Therapy that did (AutoAb+) or did not (AutoAb-) develop treatment induced autoantibody responses

Autoantibody Responses in the Androgen Dependent Shionogi Tumor Model

Interestingly, studies in an androgen-dependent mouse model has revealed that castration (the experimental equivalent of ADT) induces autoantibody responses to an antigen identified as PABPN1 in about 50% of mice. Unexpectedly, mice that developed autoantibody responses to PABPN1 had a shorter latency and higher rate of tumor recurrence, indicating that castration-induced immune responses are associated with inferior outcomes in this model (11). Preliminary experiments in the androgen-dependent Shionogi tumor model indicate that depletion of CD4+ T cells at the time of castration prolongs the time to tumor recurrence (Figure 1). In these mice, the rate of initial tumor regression is similar regardless of treatment group. Mice that received α CD4 did not show anti-body responses against PABPN1. These experiments suggest that altering that modulating the immune

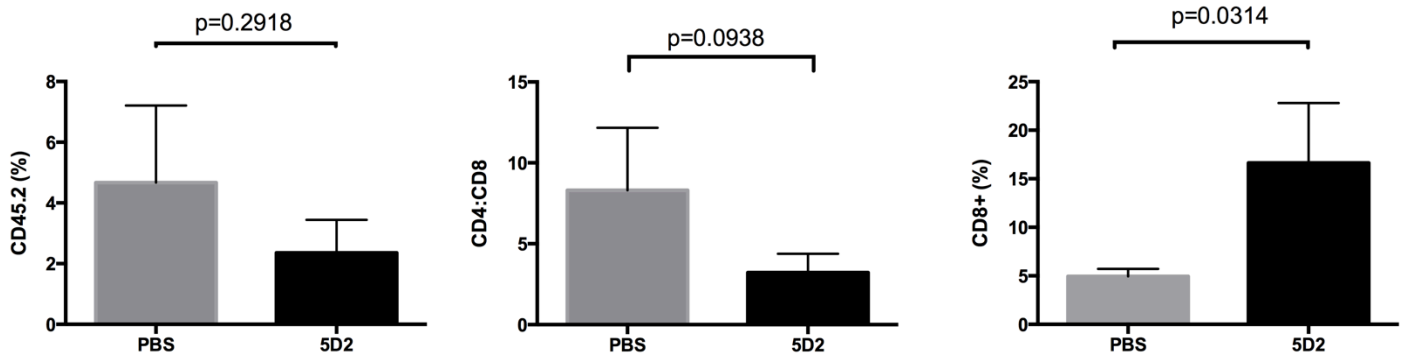


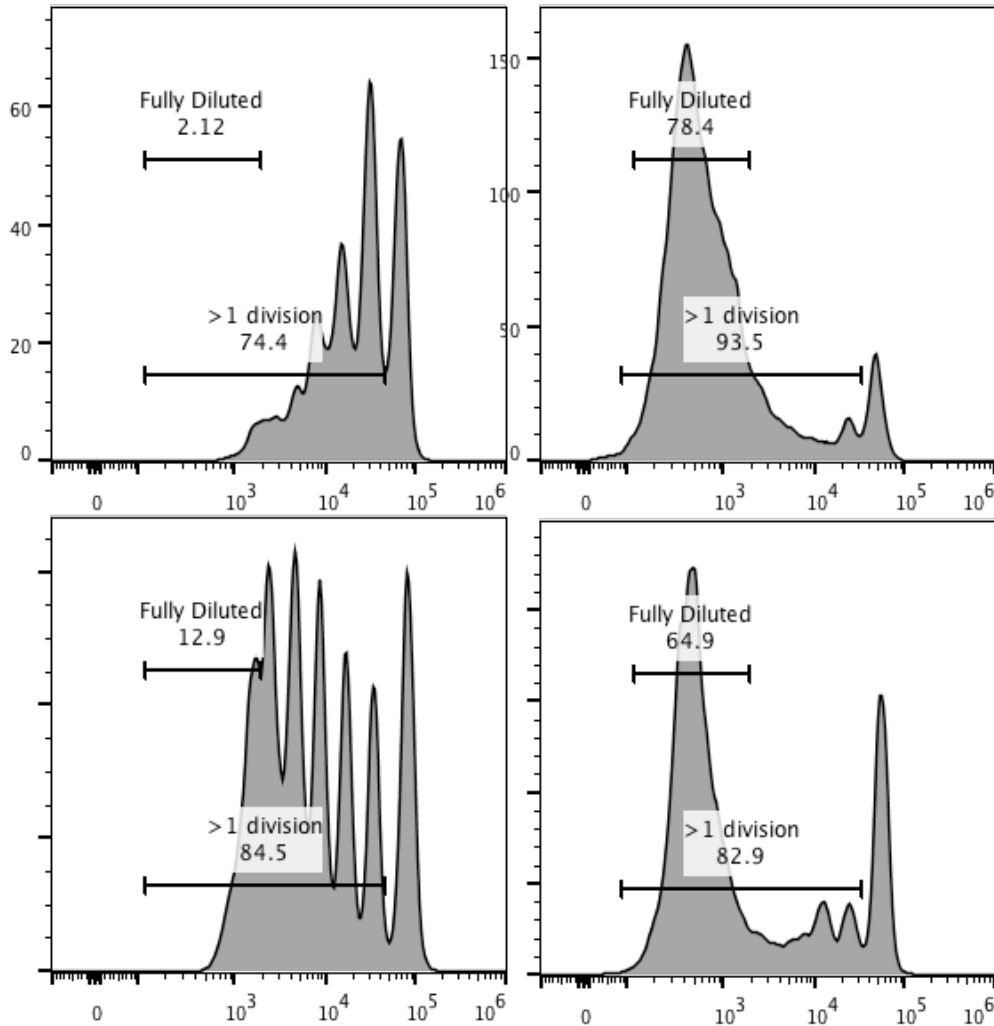
Figure 3. Infiltration of T cells Into TRAMP-C2 tumors. Tumor infiltrating hematopoietic cells were identified by CD45.2 expression (left panel). The ratio of CD4:CD8 T cells was determined by gating on CD45.2+ cells within the tumor. The percentage of CD8+ T cells was determined after gating on CD45.2+ cells. There was a significant increase in the percentage of CD8+ T cells within the tumors of CD20 depleted mice (right panel).

T cells from CD20 depleted mice are more responsive to TCR stimulation

To determine if T cells were functionally affected through the T cell receptor by B cell depletion, lymphocytes were harvested from the tumor draining lymph nodes of castrated tumor bearing mice that had received PBS or 5D2. The cells were CFSE labeled and stimulated with α CD3 for 5 days. In both groups, CD4+ and CD8+ T cells underwent division, however, the 5D2 cells were able to undergo more division and have a higher percentage of fully diluted CFSE cells in comparison to the PBS treated mice.

PBS Treated

5D2 Treated



← CFSE

Figure 4. CFSE dilution of CD4+ (top panel) CD8+ (bottom panel) T cells from the TDLN of PBS treated (left panel) or 5D2 treated mice (right panel).

Survival of CD20 Depleted Mice

Although there was an increase in cytolytic T cells into the tumor post CD20 depletion, there was no survival benefit (Figure 5). Due to unforeseen limitations on accessing radiation facilities, we were not able to perform radiation on these mice.

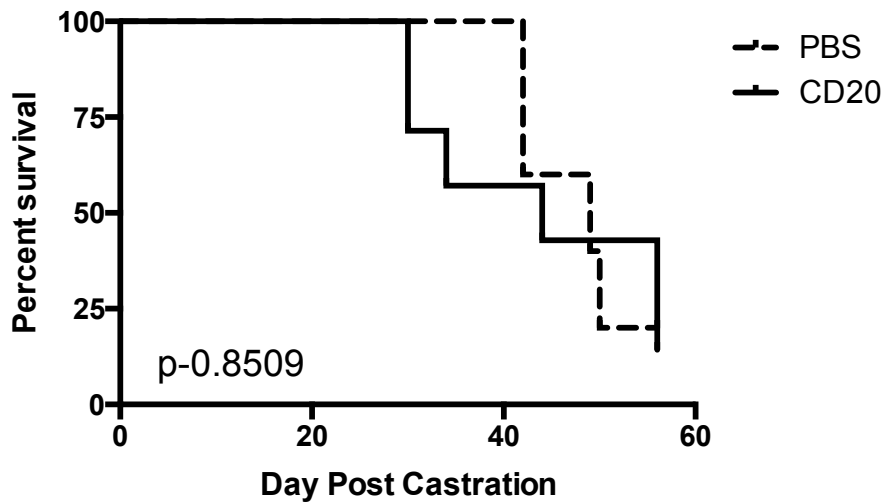


Figure 5. Survival of mice receiving α CD20 at the time of castration.

Reportable Outcomes

Although not a part of the SOW, the analysis of the patient autoantibody responses was recently accepted at the journal "Oncoimmunology" as a study titled "Tumor-associated autoantibodies correlate with poor outcomes in prostate cancer patients treated with androgen deprivation and external beam radiation therapy (Appendix II). This patient data further emphasizes the relevance of studying B cell populations in prostate cancer patients. This DoD award was acknowledged.

During the funding period, an undergraduate student, Gordon Russell, was a co-op student and received a BC Cancer Studentship to work on aspects related to this project.

Conclusion

The role of the B cell was initially thought to be the production of antibodies in response to antigenic stimulation. We (Figure 1), and others, have shown that antibody responses to tumor antigens correlate with tumor progression (12). Additionally, B cells can produce suppressive cytokines including IL-4, IL-10, and TGF- β that can play a role in blunting the ability of T cells to respond to tumors. In murine cancer models, B-cell depletion has had a variety of responses either reducing, enhancing, or having no effect on tumor control. In two studies, in a chemically induced skin cancer model and the other in an implantable breast tumor model, depletion of CD20+ cells removed regulatory B cells, which could be immunosuppressive (13, 14). Interestingly, a group recently studied the effect of B cell depletion using the same α CD20 antibody in a breast cancer model, a cancer that is also affected by hormonal regulation (15). In this case, B cell depletion through α CD20 resulted in the enrichment of B regulatory cells that express low levels of CD20.

These results indicate that CD20 depletion increases the migration of CD8+ T cells into the tumor (Figure 3). Additionally, CD8+ are able to undergo increased proliferation in the absence of CD20+ cells. (Figure 4). However, no additional survival benefit was observed (Figure 5). The increase in cytolytic T cells and improved responsiveness of CD4+ and CD8+ T cells in the tumor draining lymph nodes suggests that B cell depletion as a pre-conditioning regimen for radiation therapy specifically in prostate cancer may be therapeutically beneficial.

In the last 2 years, there has been a tremendous leap forward in the field of immuno-oncology, particularly with the advances in the clinic made with checkpoint inhibitors such as anti-CTLA-4 and anti-bodies that modulate the PD-1 pathway. In both pre-clinical and clinical models, modulation of the immune system in concert with radiation has led to dramatic observations of the abscopal effect (16, 17). In moving forward with B cell depletion, an ability to mediate sufficient response that could generate an abscopal effect will be the necessary.

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Appendix I

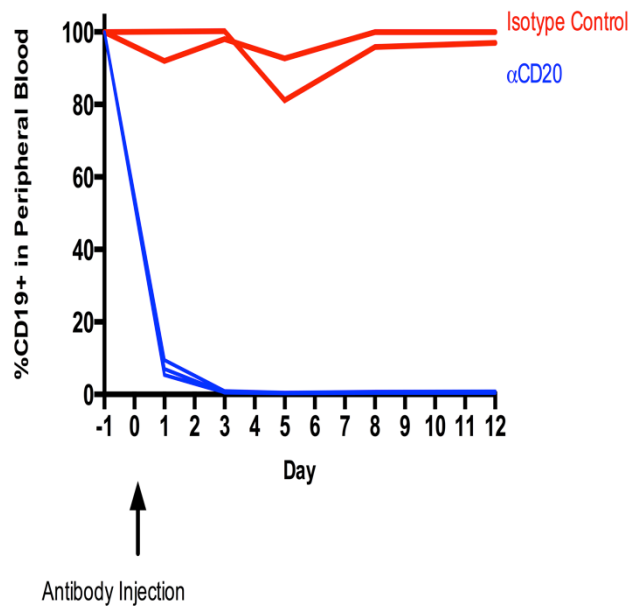


Figure 1. Levels of B cells (CD19+) in the peripheral blood of mice after injection of anti-CD20.

Tumor-associated autoantibodies correlate with poor outcomes in prostate cancer patients treated with androgen deprivation and external beam radiation therapy.

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‡. * These authors have provided equal contributions.

Running Title: Tumor antibodies indicate CaP recurrence

Keywords: prostate cancer, autoantibodies, cytokines, radiotherapy, androgen deprivation therapy

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Summary: Prostate cancer patients frequently receive radiation therapy, with or without androgen deprivation therapy. We show that treatment-associated immune responses correlate with poor outcome in patients receiving androgen deprivation and external beam radiation therapy. Thus, current treatments for prostate cancer induce detrimental immune responses in some patients. Our findings suggest that immune modulation may be warranted during hormone and radiation therapy to divert tumor immunity away from autoantibody production toward more beneficial cytolytic responses.

1 **Summary:** Prostate cancer patients frequently receive radiation therapy, with or without androgen
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3 deprivation therapy. We show that treatment-associated immune responses correlate with poor
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5 outcome in patients receiving androgen deprivation and external beam radiation therapy. Thus,
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7 current treatments for prostate cancer induce detrimental immune responses in some patients. Our
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9 findings suggest that immune modulation may be warranted during hormone and radiation therapy
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11 to divert tumor immunity away from autoantibodies toward more beneficial cytolytic responses.
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3 **ABSTRACT**
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5 **Purpose:** It is becoming increasingly clear that many standard cancer treatments trigger anti-tumor
6
7 immune responses that influence tumor control. The nature and magnitude of these responses
8
9 vary depending on the type of tumor and treatment modality. In prostate cancer, we have
10
11 previously reported that radiation and androgen deprivation therapy (ADT) induce tumor-
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13 associated autoantibody responses. In this study, we assessed the relationship between
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15 autoantibody responses and clinical outcome. Non-metastatic prostate cancer patients (n=23)
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17 received treatment with neoadjuvant & concurrent androgen deprivation therapy (ADT) and
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19 external beam radiation therapy (EBRT).
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27 **Methods and Materials:** Patient sera were collected before, during, and up to 1 year following the
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29 completion of treatment. Western blots were used to detect treatment-associated autoantibodies
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31 reactive to human prostate cancer cell line lysates. Primary outcome was biochemical recurrence
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33 using the consensus-derived Phoenix definition with a median follow-up period of 73 months.
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39 **Results:** Treatment-associated autoantibodies were detected in 30% of patients treated with ADT
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41 and EBRT. Five-year biochemical failure free survival (BFFS) was 78% for all patients. Patients
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43 that developed autoantibody responses to tumor antigens had a 57% 5-year BFFS, whereas this
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45 increased to 81% in patients that did not develop an autoantibody response.
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51 **Conclusions:** Overall, the presence of tumor reactive autoantibodies was associated with higher
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53 risk of biochemical failure (p=0.025, HR=5.99, 1.25-28.75 95% CI).
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3 **INTRODUCTION**
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6 Prostate cancer is the most common cancer in North American men. For patients with clinically
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8 localized disease, the primary treatment options are surgery or radiation therapy in the form of
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10 external beam radiation (EBRT) or brachytherapy (BT). In the case of high-risk disease (e.g.
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12 clinical stage $\geq T3$, Gleason score ≥ 8 or prostate specific antigen (PSA) >20), patients are typically
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14 offered radiation therapy in combination with androgen deprivation therapy (ADT) ^{1, 2}. In these
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16 patients, treatment with ADT and EBRT is associated with biochemical failure (BF) rates of 20% at
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18 5-years increasing to 50% at 10-years ^{3, 4}. Thus, improved treatments for high-risk prostate cancer
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21 are required.
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29 Intriguingly, ADT and EBRT appear to work synergistically to improve patient outcomes, whereas
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31 ADT does not improve outcomes when combined with radical prostatectomy ⁵. ADT is thought to
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33 increase tumor cytoreduction and apoptosis while decreasing tumor hypoxia, which may enhance
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35 the tumoricidal effects of radiation ⁶. ADT has immunological effects, such as promoting
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37 thymopoiesis, which, in turn, may facilitate infiltration of T cells into the prostate to exert anti-tumor
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39 effects ^{7, 8}. Radiation treatment can improve the ability of the immune system to recognize tumors
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41 by several mechanisms including increased expression of the death receptor Fas and enhanced
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43 antigen presentation through upregulation of Major Histocompatibility Complex (MHC) class I on
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45 tumors ⁹. In addition, there is increasing evidence that the response to radiation treatment involves
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47 a mechanism that depends on Toll-Like Receptor 4 recognition of necrotic tumor cells, a form of
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49 immunogenic cell death ¹⁰. This may, in part, also explain the abscopal effect, in which tumor
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51 regression occurs outside the radiation field ¹¹. Although the mechanisms underlying the abscopal
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53 effect have yet to be determined, it has been proposed that inflammation and tumor death at the
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55 radiation site lead to anti-tumor immune responses that can spread to non-irradiated tumors. The
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1 combination of immunogenic tumor cell death, inflammation, and enhanced antigen presentation at
2 the tumor site provides the priming and activation signals that are necessary for sustained T cell
3 mediated anti-tumor responses. As a result, ADT and EBRT may act synergistically to activate
4 immune responses against prostate cancer ^{5, 6}. Therefore, the concept of treatment-induced
5 immune responses remains an important research topic that merits further investigation.
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15 A central component of the humoral immune response is antibody production by B cells, which is
16 dependent on Th2 cytokines produced by CD4 T cells. Studies have shown that tumor-specific
17 humoral immune responses are induced by ADT, radiation, or vaccine approaches in some
18 prostate cancer patients ¹²⁻¹⁴. We have previously reported that the incidence of tumor-associated
19 autoantibodies in patients receiving ADT and EBRT was increased in comparison to those
20 receiving other treatment modalities, such as brachytherapy or radical prostatectomy ¹⁵. As the
21 development of new seroreactivities would suggest antigen spread, we anticipated that treatment-
22 induced autoantibodies would correlate with a lack of biochemical failure. In this study, we
23 assessed the relationship between treatment-associated autoantibody responses and biochemical
24 failure in a cohort of 23 patients receiving ADT and EBRT with more than 5-years median follow-
25 up. Unexpectedly, our study indicates that treatment-associated autoantibody responses may be
26 associated with unfavourable patient outcomes. While striking, it underscores the need to further
27 understand the important interaction between standard treatments and anti-cancer immunity
28 particularly as we move into an era where active immunotherapies are being deployed in the clinic.
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51 **SUBJECTS AND METHODS**

52 *Subjects.* This study received approval by the Research Ethics Board of the British Columbia
53 Cancer Agency and University of British Columbia. Fifty-six patients with non-metastatic prostate
54 cancer who had elected to receive androgen deprivation and external beam radiation therapy with
55 curative intent were recruited at the British Columbia Cancer Agency - Vancouver Island Centre in
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1 Victoria, British Columbia between December 2003 to May 2006. The majority of patients (16) had
2 high-risk disease (any of the following: stage \geq T3a, Gleason Score=8-10 PSA >20), 6 patients had
3 intermediate (stage T2b-T2c or Gleason Score=7 or PSA 10-20), and one patient had low-risk
4 disease but received ADT and EBRT due to bulky disease. Some patients were excluded from
5 further analysis because they had received ADT prior to the first blood collection or were lost to
6 follow-up. Of 56 patients recruited, 23 met the inclusion criteria for this study (Table 1).
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17 Patients received neoadjuvant and concomitant ADT as single agent or combination regimens at
18 the discretion of the treating physicians. Regimens were typically a combination of a luteinizing
19 hormone-releasing agonist and an anti-androgen. Neoadjuvant ADT was typically given for one-
20 year prior and concurrently with EBRT. EBRT was planned and treated with 3D conformal EBRT
21 techniques, using computerized tomography simulation, multi-field beam arrangement to target the
22 prostate gland and seminal vesicles. The prescribed dose of EBRT was 74 Gy delivered in 2 Gy
23 daily fractions over a period of 7.5 weeks.
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37 *Blood Collection.* Blood samples were collected with informed written consent from study
38 participants. Serum was collected at the first visit, and subsequent serum samples were collected
39 at approximately 3-month intervals during treatment, followed by 6-month intervals for the first year
40 after treatment and timed to coincide with clinical assessment of PSA. Blood was collected in
41 serum separator tubes, centrifuged at 2500 rpm for 10 min, aliquoted and stored at -80°C. PSA
42 values were obtained from patient records. Biochemical failure was defined as nadir +2 ng/ml as
43 per the Phoenix definition ¹⁶.
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56 *Detection of autoantibodies by immunoblotting.* Western blots were performed as previously
57 described ¹⁵. The human prostate cancer cell line LNCaP was obtained from the American Type
58 Culture Collection. Briefly, 400 μ g of protein isolated from LNCaP cells was separated on a single
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1 lane by standard SDS-PAGE and transferred to nitrocellulose. Sera were diluted 1:500 in Blotto
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3 (5% dry milk powder, 0.1% Tween 20, 50 mmol/L Tris, 150 mmol/L NaCl) and incubated for 1 hour
4
5 at room temperature using the Mini Protean II MultiScreen multichannel immunoblotting device
6
7 (Bio-Rad, Mississauga, ON). Membranes were incubated for 1 hour at room temperature with
8
9 horseradish peroxidase-conjugated goat anti-human IgG secondary antibody (1:10,000; Heavy and
10
11 Light chains; Jackson ImmunoResearch) and visualized by enhanced chemiluminescence. All
12
13 serum samples were assessed by immunoblot at least twice. Autoantibody responses were
14
15 considered positive if they developed within one-year of completing EBRT.
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22 *Detection of actin by immunoblotting.* Nitrocellulose membranes were rehydrated in water for 10
23
24 minutes. To remove the primary human sera and secondary IgG, blots were incubated for 10
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26 minutes at room temperature with gentle shaking in Restore™ Western Blot Stripping Buffer
27
28 (Thermo Scientific). Blots were then washed thoroughly (5 times for 5 minutes at room
29
30 temperature) in TBST. A 5% milk solution was used to block and blots were reprobed with mouse
31
32 anti-actin (Sigma #A2228) at a 1:50,000 dilution overnight at 4°C with gentle shaking. The next
33
34 day, blots were washed 5 times for 5 minutes at room temperature in TBST followed by incubation
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36 with anti-mouse IgG IR800 secondary antibody (Rockland #610-132-121; 1:20,000). After 1 hour
37
38 in secondary antibody, blots were washed and imaged using Li-Cor Odyssey Imager.
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46 *Statistical analysis.* Log-rank tests were performed to determine significance for biochemical failure
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48 in autoantibody positive and negative patients. Risk, which incorporates stage, Gleason score, and
49
50 PSA level, and the development of autoantibodies was analyzed by Cox regression analysis.
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56 **RESULTS**

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59 *Detection of tumor-associated autoantibodies.* To assess treatment-associated immune responses,
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61 patient sera were immunoblotted against whole cell lysates from the human prostate cancer cell
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1 line LNCaP as previously described ¹⁵. All results were confirmed by at least two independent
2 immunoblots. Sera were scored as positive if they showed the appearance of one or more bands
3 by Western blot during or within one year of treatment. Seven of the twenty-three (30.4%) patients
4 developed one or more seroreactivities. Of the sixteen high-risk patients, 6 (37.5%) developed
5 autoantibody responses and one (16%) of the intermediate risk patients did as well. The low risk
6 patient that was treated with ADT and EBRT did not develop an autoantibody response. In four of
7 these patients (57.1 %), new seroreactivity was observed after ADT but before EBRT. Figure 1
8 shows the Western blot results for two healthy donor controls (Fig. 1A), one representative patient
9 who did not develop autoantibodies (Fig. 1B; Patient 052), and two representative patients (Fig.
10 1C; Patient 054, Fig 1D; Patient 170; arrows) who scored positive for treatment-associated
11 autoantibodies.

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29 *Autoantibody responses are associated with poor prognosis following ADT and EBRT.* The median
30 follow-up time (the time from the end of treatment to the last available PSA value or death) was 73
31 months (range 18 – 108 months). Nine patients (39.1%) experienced BF. Of the seven patients
32 who were autoantibody positive, five (71.4%) experienced BF. By Kaplan-Meier analysis, patients
33 who developed autoantibody responses during treatment showed a significantly higher rate of BF
34 (Fig. 1C; p=0.025, HR=5.99, 1.25-28.75 95% CI). Multivariate analysis was performed with risk
35 group and autoantibody status (Table 2). This analysis indicated that neither risk group (p= 0.704,
36 HR 1.342, 0.294-6.126) nor the development of autoantibodies (p=0.058, HR 4.283, 0.954-19.224)
37 is a significant independent predictor of BF (Table 2), likely due to the small number of patients in
38 this study cohort.

DISCUSSION

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3 Tumor-associated autoantibodies are detectable in patients with a variety of cancers including
4
5 prostate cancer and may have prognostic value ¹⁷. The current study was undertaken to
6
7 investigate whether standard therapies could, a) result in tumor-associated humoral responses and
8
9 b) whether these changes correlate with treatment outcomes in patients receiving ADT and EBRT.
10
11 For high risk and some intermediate risk disease, the combination of ADT and EBRT is a standard
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13 treatment option but is associated with biochemical failure > 20% at 5 years for patients with more
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15 aggressive disease ¹⁸. Of the patients treated with ADT and EBRT, 30.4% developed an
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17 autoantibody response during or within one year of treatment. Of the autoantibody positive
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19 patients, 71.4% experienced BF compared to only 25% of patients without autoantibody
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21 responses.
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30 These results are consistent with our laboratory findings in the Shionogi tumor model where the
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32 detection of autoantibodies specific for poly(A) binding protein correlated with tumor recurrence
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34 after androgen deprivation by castration ¹⁹. In another study evaluating autoantibody responses in
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36 patients receiving a poxvirus-based vaccine and EBRT, autoantibody responses had no impact on
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38 survival ¹³. However, when stratified by certain antigen-specific autoantibodies, a trend towards
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40 worse outcomes was observed ¹³. The specificity of the antigen responses may be essential to
41
42 determine whether or not autoantibody responses are beneficial or detrimental. Smith and
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44 colleagues noted that autoantibody responses to specific tumor antigens varied between
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46 individuals as well as type of treatment ¹². We found that the majority of autoantibody responses
47
48 coincide with BF, suggesting that this type of the immune response might promote disease
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50 recurrence. However, these conclusions will require validation on a larger cohort of patients, as
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52 well as further investigation to uncover the underlying mechanism of these autoantibody
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54 responses.
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1 The increased rate of BF in patients with tumor-associated autoantibodies indicates that B cell
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3 activation may promote tumor aggressiveness. It is possible that the combination of ADT with
4
5 EBRT promotes a tumor microenvironment where stimulation of prostate-resident B cells results in
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7 chronic production of inflammatory cytokines that leads to tumor progression ²¹. Consistent with
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9 this alternative hypothesis is a report demonstrating that autoantibody production in the K14-
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11 HPV16 model of squamous carcinogenesis recruits and regulates tumor associated macrophages
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13 and mononuclear phagocytes through interaction of IgG with Fcγ receptors suggesting that the
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15 detection of autoantibodies in the serum of patients may represent an immunosuppressive tumor
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17 environment ²². Moreover, a recent finding by Karin and colleagues showed that tumor infiltrating B
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19 cells can directly promote the development of androgen-independent prostate cancer progression
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21 via the production of pro-inflammatory cytokines, specifically lymphotoxin-α ²³. In another study of
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23 colon cancer, depletion of B cells augmented anti-tumor responses and suppressed metastasis ²⁴.
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25 Taken together, these data suggest that B cells may contribute to tumor pathogenesis in prostate
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27 cancer and that immune modulation through B cell depletion or blockade of inflammatory cytokines
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29 produced by B cells could be therapeutically beneficial in a subset of prostate cancer patients that
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31 receive ADT + EBRT.
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41 Patients receiving ADT + EBRT represent those with the highest risk for recurrence, and within this
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43 patient population we have identified a sub-group of patients with a deleterious immune response
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45 that has a higher risk of recurrence. Randomized clinical trials have demonstrated that the addition
46
47 of ADT to EBRT results in enhancing rather than compromising prostate cancer control and
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49 survival, but is still associated with high rates of biochemical failure ². Understanding the
50
51 immunological profile of those patients with unfavourable prognosis may help to stratify patients
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53 that would benefit most from additional treatments, such as B cell depletion. Longitudinal
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55 monitoring of our prostate cancer patients is needed to shed light on the interactions amongst B
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57 and T cells and their respective contributions to treatment-associated immune responses.
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1 Preventing autoantibody development and inducing a more beneficial Th1 response may prove to
2
3 be important directions for treatment of high-risk prostate cancer patients. Such investigations will
4
5 pave the way for the development of immunomodulating agents that improve the effectiveness of
6
7 standard therapies for this disease.
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2 **Figure 1.** Treatment-associated responses to prostate tumor antigens. Western blot analysis of serum
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4 from 2 healthy donor controls and 3 patients probed against LNCaP cell lysate. The timing of the
5
6 sample collection for each patient is indicated. New seroreactivities are indicated with an arrow. (A)
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8 Two health donor controls showed no seroreactivity, (B) patient 052 who did not develop an
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10 autoantibody response throughout treatment, (C) patient 054 who was treated with ADT + EBRT
11
12 developed a new response 8 months post EBRT and (D) patient 170, who developed two new
13
14 responses 1 month post EBRT. Each blot was re-probed against actin without the multichannel device to
15
16 ensure equal protein loading across each lane. The lines indicate the original slot blot lane for each
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18 sample.
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26 **Figure 2.** Treatment-associated autoantibody responses are associated with increased likelihood of
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28 biochemical failure. Kaplan-Meier analysis of biochemical failure according to development of an
29
30 autoantibody response. Autoantibody negative subjects are indicated with a solid line, autoantibody
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32 positive subjects are indicated with a dashed line. Tick marks indicate censored subjects. A log-rank test
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34 was performed to determine the p-value.
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Table 1. Subject Characteristics	
Number of Subjects	23
Age, median (range)	69.7 (51.3-81.2)
Gleason Score, n (%)	
6	7 (30.4)
7	11 (47.9)
8-10	5 (21.7)
Stage, n (%)	
T1	8 (34.8)
T2	12 (52.2)
T3	3 (13.0)
PSA at diagnosis Median (ng/ml) (range)	11.0 (3.1-100)
Risk group, n (%)	
Low	1 (4.3)
Intermediate	6 (26.1)
High	16 (69.6)

Table 2. Cox-multivariate analysis			
Variable	Hazard Ratio	95% CI	p-value
Risk Group	1.342	0.294-6.126	0.704
Autoantibody Status	4.283	0.954-19.224	0.058

Figure 1
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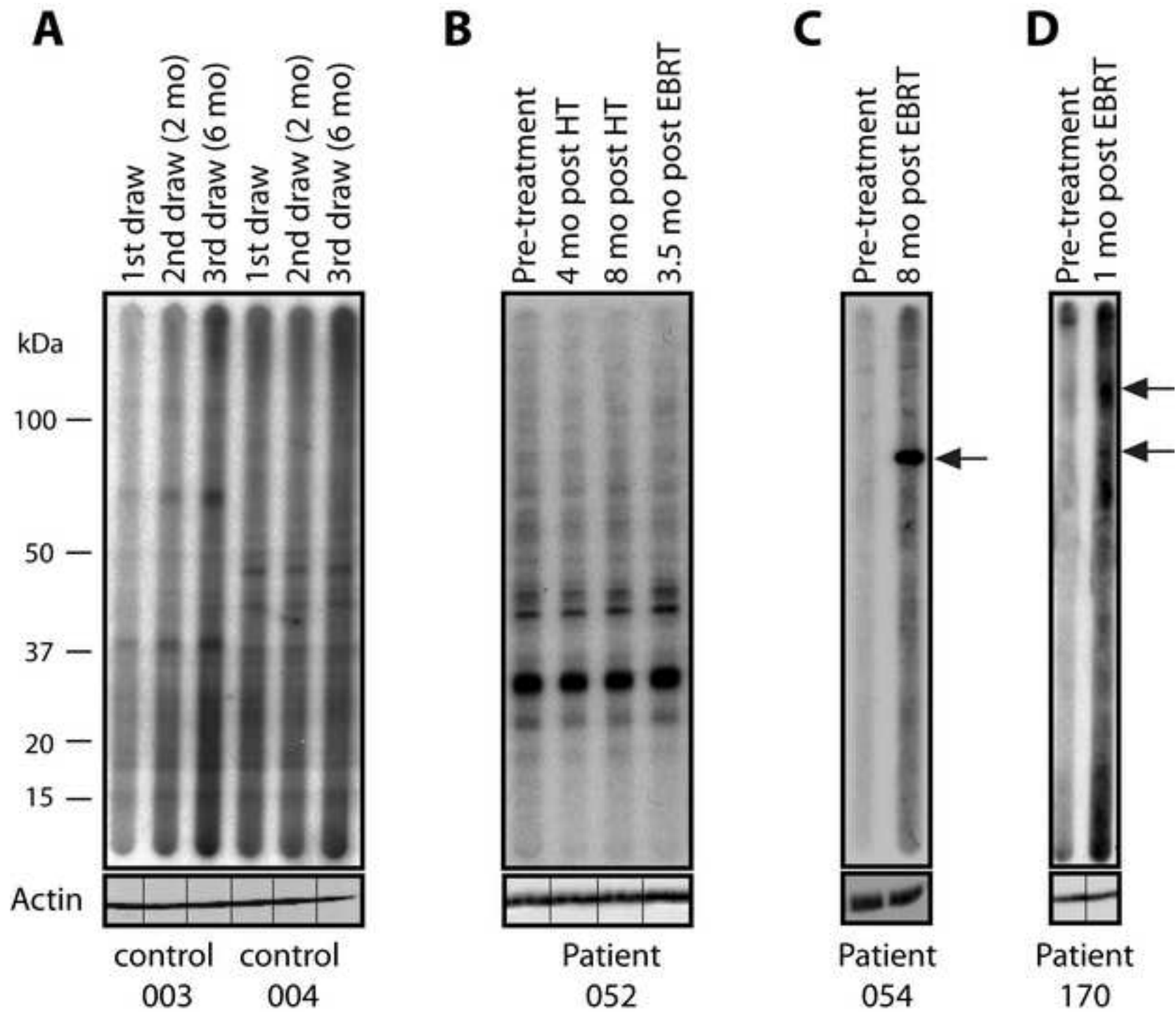


Figure 2
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