REVIEW

Endorsed by the Genitourinary Medical Oncologists of Canada (GUMOC)

Expert opinion on the management of anemia in prostate cancer patients receiving PARP inhibitors

Lilian Hanna[1], Richard O'Dwyer[2], Zineb Hamilou[3], Krista Noonan[4], Sarah Doucette[5], Srikala S. Sridhar[2]

[1]Department of Medical Oncology, Verspeeten Family Cancer Centre, London Health Sciences Centre, London, ON, Canada; [2]Division of Medical Oncology, Princess Margaret Cancer Centre, University Health Network, University of Toronto, Toronto, ON, Canada, Mater Misericordiae University Hospital and Cavan General Hospital, Dublin, Ireland; [3]Department of Medicine, Hematology-Oncology Division, Centre Hospitalier de l'Université de Montréal (CHUM), Montreal, QC, Canada; [4]Department of Medical Oncology, BC Cancer, Surrey, BC, Canada; [5]Impact Medicom Inc., Toronto, ON, Canada

Cite as: Hanna L, O'Dwyer R, Hamilou Z, et al. Expert opinion on the management of anemia in prostate cancer patients receiving PARP inhibitors. *Can Urol Assoc J* 2025;19(12):422-31. http://dx.doi.org/10.5489/cuaj.9401

ABSTRACT

Metastatic castration-resistant prostate cancer (mCRPC) is incurable, with tumors often relapsing after initial treatment and patients requiring subsequent lines of therapy. As the use of androgen receptor pathway inhibitors (ARPIs), with or without docetaxel, prior to the development of castration-resistant disease is increasing, the number of subsequent therapy options for mCRPC is limited.

Poly (ADP-ribose) polymerase (PARP) inhibitors are one treatment option approved in Canada for patients with mCRPC and mutations in *BRCA1/BRCA2* or other homologous recombination repair (HRR) genes. PARP inhibitors are generally well-tolerated but are associated with high rates of anemia. This can be difficult to manage in mCRPC, as common disease and patient characteristics, as well as prior therapy, also contribute to an increased risk of anemia. Appropriate management of anemia is important for maintaining quality of life; however, there is a paucity of data and guidelines to inform clinicians on how to best prevent and manage anemia associated with PARP inhibitor use in mCRPC.

This narrative review and expert opinion provides key strategies for managing anemia related to PARP inhibitor use in mCRPC through prevention, monitoring, and supportive care.

INTRODUCTION

Prostate cancer is the most commonly diagnosed cancer among males in Canada, with an age-standardized incidence rate of 120 per 100 000 males per year.[1] It is estimated that 11% of all cancer-associated deaths in Canadian men in 2024 were attributed to prostate cancer.[1] While the majority of cases present in the localized stage, which has an excellent five-year survival rate of >99%, advanced prostate cancer is incurable, with poor five-year net survival rates of 41%.[2]

In North America, the current first-line therapy for metastatic castration-sensitive prostate cancer (mCSPC) is androgen deprivation therapy (ADT) in combination with androgen receptor pathway inhibitors (ARPIs), with or without docetaxel.[3] Real-world data suggest that a growing number of patients will have received intensified treatment with ADT and at least an ARPI prior to developing castration-resistant disease.[4,5] Prior exposure to an ARPI and/or docetaxel may limit the number of subsequent therapies available for patients with metastatic castration-resistant prostate cancer (mCRPC).

In the absence of biomarker information and prior to the advent of lutetium-177 therapy in prostate-specific membrane antigen (PSMA) positron emission tomography (PET) scan-positive disease and poly (ADP-ribose) polymerase (PARP) inhibitors in patients with homologous recombination repair (HRR) deficits, life-prolonging therapy for patients with mCRPC who progress on prior

ARPIs was limited to chemotherapy (docetaxel, cabazitaxel), an alternate ARPI, or radioligand therapy with radium-223;[6-8] however, treatment resistance and disease progression were inevitable, shortening life expectancy even if there was an initial response.

PARP inhibitors have demonstrated efficacy in mCRPC patients with mutations in genes involved in HRR pathways. This constitutes up to 30% of patients with advanced prostate cancer.[9,10] PARP inhibitors work by promoting synthetic lethality in HRR-deficient cancers. That is, they interfere with PARP-led initiation of single-strand DNA break repair, causing double-strand DNA breaks, which accumulate in the context of HRR deficiency, ultimately triggering genomic instability and cell death.[11] The use of PARP inhibitors in the mCRPC setting, either as monotherapy or in combination with ARPIs, has been supported by multiple phase 3 clinical trials, which led to the Health Canada approval of multiple PARP inhibitor-based regimens for the treatment of HRR-mutated mCRPC.[12-14]

Although PARP inhibitors are generally well-tolerated, high rates of anemia have been reported in clinical trials across multiple disease sites, and was a major cause for dose modifications and interruptions in these trials.[15-20] Anemia occurs frequently in mCRPC patients, but the exact incidence is unclear.[21] Appropriate management of anemia is important since anemia is an independent factor associated with poor prognosis and decreased quality of life in patients with metastatic prostate cancer.[22] There is, however, a paucity of data and guidelines to inform clinicians on how best to prevent and manage anemia associated with PARP inhibitor use in mCRPC.

This paper provides a narrative review and expert opinion on managing anemia related to PARP inhibitor use in mCRPC.

METHODS

Relevant literature was identified through a targeted search of PubMed (up to December 2024), focusing on published clinical trials of PARP inhibitors in mCRPC. Backward and forward citation tracking of these studies was used to identify additional publications. Further relevant articles were obtained by consulting previously published review articles on PARP inhibitors, advanced prostate cancer, and anemia in cancer patients. Literature on the management of anemia in oncology and, specifically, in prostate cancer patients was also reviewed to provide clinical context.

This paper provides expert opinion on the management of anemia for patients with mCRPC receiving PARP inhibitors. The expert panel was composed of Canadian specialists in the treatment of prostate cancer (including four medical oncologists and one hemato-oncologist), who came together through professional networking and a mutual interest in addressing this clinical challenge. Recommendations were based on evidence from clinical trials, study protocols, international guidelines, and clinical experience/expert opinion. Consensus on recommendations and perspectives was achieved through iterative meetings and communications, with all panel members reviewing the evidence, providing feedback, and agreeing upon the final guidance. The final manuscript was reviewed and endorsed by the Genitourinary Medical Oncologists of Canada (GUMOC).

CLINICAL BENEFIT OF PARP INHIBITORS IN MCRPC AND HEALTH CANADA INDICATIONS

PARP inhibitors have been investigated in clinical trials for mCRPC, both as monotherapy and in combination with ARPIs (Table 1). Currently, olaparib is the only PARP inhibitor approved as monotherapy in Canada for patients with *BRCA1/2*- or *ATM*-mutated mCRPC who have progressed following prior treatment with an ARPI.[13] This is based on results from the phase 3, randomized PROfound trial, which reported a significant reduction in the risk of progression for this patient population when treated with olaparib monotherapy compared with physician's choice of enzalutamide or abiraterone.[17]

At the time of publication, both olaparib and niraparib have been approved by Health Canada in combination with abiraterone and prednisone for patients with *BRCA*-mutated mCRPC in whom chemotherapy is not indicated.[13,14] These approvals were based on the phase 3 PROpel (olaparib) and MAGNITUDE (niraparib) trials, which reported a significant progression-free survival (PFS) benefit for PARP inhibitor combination therapy compared with the control arms of abiraterone and prednisone plus placebo for patients with *BRCA1/2*-mutated mCRPC (Table 1).[23,24] The TALAPRO-2 study also demonstrated improved PFS for talazoparib plus enzalutamide vs. placebo plus enzalutamide in HRR-mutated mCRPC, leading to a Health Canada indication for talazoparib and enzalutamide in this setting.[12,25] All patients defined as having a HRR mutation in these trials benefited from treatment with PARP inhibitors; however, exploratory analyses have shown that the greatest benefit is seen in patients with *BRCA1/2* mutations.[15,26]

It is imperative to perform genetic testing on advanced prostate cancer patients, as it may guide treat-

Table 1. Key clinical trials of PARP inhibitor therapy in mCRPC

	Population	Arms	Efficacy results (PARPi arm vs. control arm)			Safety results related to anemia		
			ORR (RECIST v1.1)	rPFS, median months (HR [95% CI]), p	OS, median months (HR [95% CI]), p	Rate (PARPi vs. control)	Dose changes	Supportive care
PARP inhibitor monotherapy in mCRPC progressing on ARPI and taxane therapy								
PROfound[a,17,65,66] **Phase 3**	Cohort A: *BRCA1*, *BRCA2*, ATM (n=245) Cohort B: HRRm (n=142)	Olaparib 300 mg BID vs. physician's choice of ENZA or ABI	Cohort A: 33% vs. 2% Cohort B: Not reported	Cohort A[b,c]: 7.4 vs. 3.6 (0.34 [0.25–0.47]), p<0.001 Cohort B: Not reported	Cohort A: 20.1 vs. 14.4 (0.63 [0.42–0.95]) Cohort B: 14.1 vs. 11.5 (0.96 [0.63–1.49])	Any grade: 50% vs. 15% Grade ≥3: 23% vs. 5%	Disc: 7%	Not reported
GALAHAD[18] **Phase 2**	HRRm (N=289) *BRCA* cohort: (n=142) Non-*BRCA* cohort: (n=81)	Niraparib 300 mg QD	*BRCA* cohort[b]: 34.2% Non-*BRCA* cohort: 10.6%	*BRCA* cohort: 8.08 Non-*BRCA* cohort: 3.71	*BRCA* cohort: 13.01 Non-*BRCA* cohort: 9.63	Any grade: 54% Grade ≥3: 33%	Disc: 2.4% Reduction: 16.6%	EPO: 5% Blood transfusion: 46%[d]
TALAPRO-1[16] **Phase 2**	HRRm (N=127)	Talazoparib 1 mg QD	Overall[b,c]: 29.8% *BRCA2*: 46% *BRCA1*: 50% PALB2: 25% ATM: 12%	Overall: 5.6 *BRCA1/2*: 11.2 ATM: 3.5	Overall: 16.4	Any grade: 49% Grade ≥3: 31%	Disc: 0% Interruption: 19% Reduction: 22%	RBCs: 29.9%
TRITON2[30] **Phase 2**	HRRm (N=277) *BRCA* (n=172) ATM (n=59) PALB2 (n=11)	Rucaparib 600 mg BID	*BRCA*[b,c]: 46% PALB2: 100% ATM/CDK12/CHEK2: 0%	*BRCA*: 10.7 ATM: 5.3 PALB2: 13.6	*BRCA*: 17.2 ATM: 14.6 PALB2: 17.7	Any grade: 48% Grade ≥3: 29%	Disc: 3%	Not reported

[a]Patients were stratified by whether they had received previous taxane. [b]Denotes primary endpoint. [c]Denotes blinded independent central review. [d]Includes transfusions with platelets or packed RBCs. [e]Two-sided boundary for significance 0.0377. ABI: abiraterone; ARPI: androgen receptor pathway inhibitor; BID: twice-daily; CI: confidence interval; Disc: discontinuation; ENZA: enzalutamide; EPO: erythropoietin; ESA: erythropoietin stimulating agent; HR: hazard ratio; HRRm: mutation in homologous recombination repair gene(s); OS: overall survival; PARPi: poly [ADP-ribose] polymerase inhibitor; QD: once-daily; RBCs: red blood cells; rPFS: radiographic progression-free survival.

ment sequencing strategies. For example, sequencing PARP inhibitors prior to chemotherapy is an evidenced-based strategy based on data from the TRITON-3 trial. Although not yet approved by Health Canada, rucaparib demonstrated significantly longer PFS vs. physician's choice of control in the phase 3 TRITON-3 study, which enrolled patients with *BRCA1*-, *BRCA2*-, or *ATM*-mutated mCRPC.[27] Notably, a significant PFS improvement was observed when comparing rucaparib to the subgroup of patients in the control arm who received docetaxel. With this evidence and the fact that only 50% of patients receiving first-line therapy for metastatic prostate cancer are able to receive subsequent-line therapy,[28,29] all patients with metastatic prostate cancer should have germline and/or somatic testing for *BRCA1/2* and other HRR gene mutations, so that PARP inhibitor treatment can be considered prior to chemotherapy.

Table 1 (cont'd). Key clinical trials of PARP inhibitor therapy in mCRPC

	Population	Arms	Efficacy results (PARPi arm vs. control arm)			Safety results related to anemia		
			ORR (RECIST v1.1)	rPFS, median months (HR [95% CI]), p	OS, median months (HR [95% CI]), p	Rate (PARPi vs. control)	Dose changes	Supportive care
PARP inhibitor therapy combined with ARPI in first-line mCRPC								
PROpel[15,23,39] **Phase 3**	Unselected for HRRm (N=796)	Olaparib 300 mg BID + ABI vs. placebo + ABI	58.4% vs. 48.1%	Overall[b]: 24.8 vs. 16.6 (0.66 [0.54–0.81]), p<0.001 HRRm: NR vs. 13.9 (HR 0.5 [0.34–0.73]) Non-HRRm: 24.1 vs. 19.0 (0.76 [0.60–0.97])	Overall: 42.1 vs. 34.7 (HR 0.81 [0.67–1.00], p = 0.054[e]	Any grade: 46% vs. 16% Grade ≥3: 15% vs. 3%	Disc: 3.8% vs. 0.8% Interruption: 15.6% vs. 1.8% Reduction: 10.6% vs. 0.5%	Blood transfusion: 15.6% vs. 3.8% EPO/ESA: 0.5% vs. 0.3%
MAGNITUDE[19,24] **Phase 3**	HRRm (N=423) *BRCA1/2* (n=225)	Niraparib 200 mg BID + ABI vs. placebo + ABI	*BRCA1/2*: 52% vs. 31% HRRm: 60% vs. 28%	*BRCA1/2*[b,c]: 19.5 vs. 10.9 (0.55 [0.39–0.78]), p=0.0007 HRRm: 16.7 vs. 13.7 (0.76 [0.60–0.97])	*BRCA1/2*: 29.3 vs. 28.6 (0.88 [0.58–1.34]), p=0.5505 HRRm: 29.3 vs. 32.2 (1.01 [0.75–1.36])	Any grade 50.0% vs. 22.7% Grade ≥3 30.2% vs. 8.5%	Disc: 2.4% Reduction: 13.2%	Blood transfusion: 27.4% vs. 5.2%
TALA-PRO-2[25,26,35,36,67] **Phase 3**	Cohort 1 – Unselected for HRRm (N=805) Cohort 2 – HRRm (n=399)	0.5 mg QD talazoparib + ENZA vs. placebo + ENZA	Cohort 1: 62% vs. 44% Cohort 2: 69% vs. 38%	Cohort 1[b,c]: 33.1 vs. 19.5 (0.67 [0.55–0.81]), p<0.0001 Cohort 2: 30.7 vs. 12.3; (0.47 [0.36–0.61]), p<0.0001 *BRCA1/2*: NR vs. 11.0 (0.26 [0.16–0.42]) Non-*BRCA*: 24.7 vs. 16.6 (0.65 [0.47–0.91])	Cohort 1: 45.8 vs. 37.0 (0.80 [0.66– 0.96]), p=0.016 Cohort 2: 45.1 vs. 31.1 (0.62 [0.48–0.81]), p=0.0005 *BRCA1/2*: NR vs. 28.5 (0.50 [0.32–0.78]) Non-*BRCA*: 42.4 vs. 32.6 (0.73 [0.52–1.02])	Cohort 1: Any grade: 68% vs. 20% Grade ≥3: 49% vs. 4% Cohort 2: Any grade: 67% vs. 19% Grade ≥3: 43% vs. 5%	Cohort 1: Disc: 8% Interruption: 44.2% Reduction: 43.2% Cohort 2: Disc: 5% Interruption: 43% Reduction: 45%	Cohort 1 ESAs: 8.3% Packed RBCs: 39.2% Cohort 2: ESAs: 7.6% Packed RBCs: 35.9%
TRITON3[27]	*BRCA1/2* or ATM (N=405)	Rucaparib 600 mg BID vs. physician's choice of docetaxel, ENZA or ABI	*BRCA1/2*: 45% vs. 17% Overall: 35% vs. 16% ATM: 0% vs. 14%	*BRCA1/2*[b,c]: 11.2 vs. 6.4 (0.50 [0.36–0.69]), p<0.001 Overall[b,c] 10.2 vs. 6.4 (0.61 [0.47-0.80]); p< 0.001 ATM: 8.1 vs. 6.8 (0.95 [0.59-1.52])	*BRCA1/2*: 24.3 vs. 20.8 (0.81 [0.58–1.12]), p=0.21 Overall: 23.6 vs. 20.9 (0.94 [0.72–1.23]) ATM: 21.1 vs. 21.7 (1.20 [0.74–1.95])	Any grade: 47% vs. 18% Grade ≥3: 24% vs. 1%	Not reported	Not reported

[a]Patients were stratified by whether they had received previous taxane. [b]Denotes primary endpoint. [c]Denotes blinded independent central review. [d]Includes transfusions with platelets or packed RBCs. [e]Two-sided boundary for significance 0.0377. ABI: abiraterone; ARPI: androgen receptor pathway inhibitor; BID: twice-daily; CI: confidence interval; Disc: discontinuation; ENZA: enzalutamide; EPO: erythropoietin; ESA: erythropoietin stimulating agent; HR: hazard ratio; HRRm: mutation in homologous recombination repair gene(s); NR: not reached; OS: overall survival; PARPi: poly [ADP-ribose] polymerase inhibitor; QD: once-daily; RBCs: red blood cells; rPFS: radiographic progression-free survival.

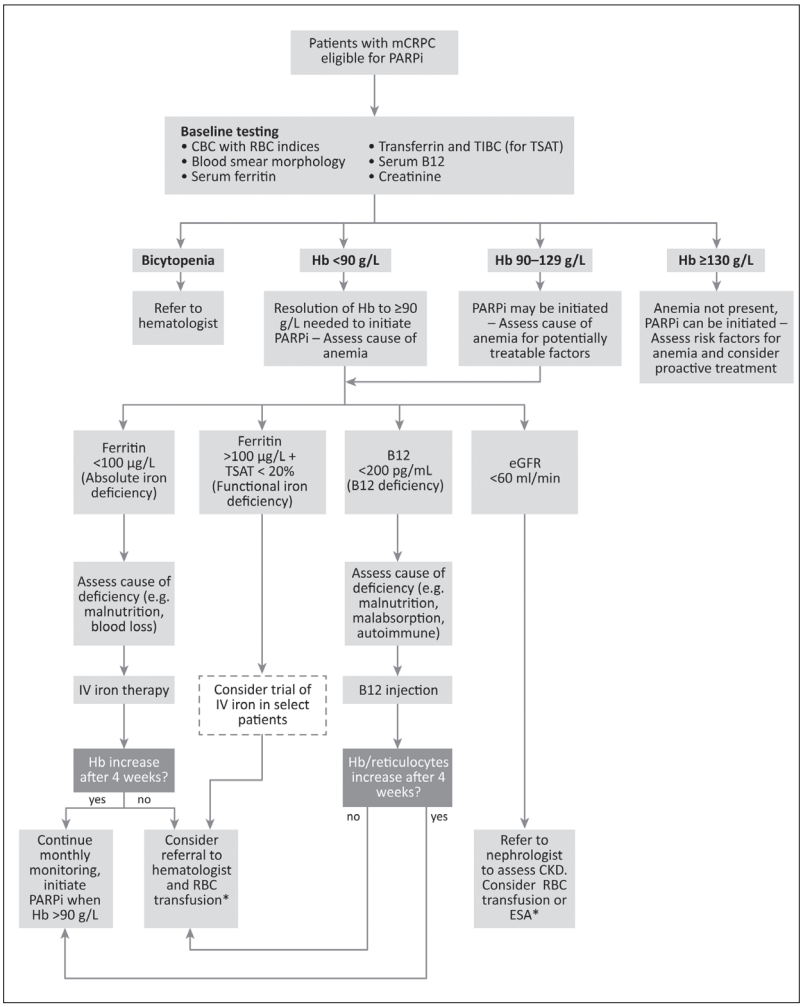

Figure 1. Baseline assessment of anemia and common etiologies. *RBC transfusion is generally considered in a patient with Hb <70 g/L and may be considered with Hb 70–90 g/L if the patient is symptomatic or with high-risk comorbidities (e.g., cardiac symptoms). ESAs are used for the treatment of anemia caused by CKD and may be considered in a patient with mCRPC with CKD who is dependent on blood transfusion. Careful consideration of potential risks and benefits should be discussed with a multidisciplinary team. CBC: complete blood count; CKD: chronic kidney disease; eGFR: estimated glomerular filtration rate; ESA: erythropoietin-stimulating agent; Hb: hemoglobin; IV: intravenous; mCRPC: metastatic castration-resistant prostate cancer; PARPi: poly [ADP-ribose] polymerase inhibitor; RBC: red blood cell; TSAT: transferrin saturation.

TOXICITIES OF PARP INHIBITORS: ANEMIA INCIDENCE AND PRESENTATION

Fatigue, nausea, and anemia were the most common adverse events reported in all clinical trials of PARP inhibitors in mCRPC.[16-18,23-25,27,30] Anemia was also the most common grade ≥3 adverse event (AE) and the most common AE leading to treatment discontinuation. Anemia appears to be a class effect of PARP inhibitors, typically presenting as macrocytic or normocytic erythroblastic anemia in the absence of folate or B12 deficiency.[31] Although the mechanism by which PARP inhibitors cause anemia in humans is unclear, in vitro and in vivo (mouse model) studies suggest inhibition of PARP1 and PARP2 disrupts cell differentiation in the bone marrow and erythropoiesis.[32-34]

There does not appear to be a substantial difference in anemia frequency between different PARP inhibitors used in prostate cancer trials, or between monotherapy and combination therapy (Table 1). Rates of any grade and grade ≥3 anemia were 48–54% and 23–33%, respectively, in the trials investigating PARP inhibitor monotherapy.[16-18,30] Similar rates of anemia were reported in trials investigating PARP inhibitors in combination with ARPIs, with any grade anemia generally ranging from 46–50% and grade ≥3 anemia ranging from 15–30%.[23,24,27] The highest rate of anemia reported in PARP inhibitor trials for mCRPC was in TALAPRO-2, where any grade and grade ≥3 anemia were reported in 68% and 49% of patients receiving talazoparib plus enzalutamide, respectively.[35] The higher rates of anemia in the TALAPRO-2 trial may be in part due to 49% of patients having grade 1 or 2 anemia at baseline.[36] Importantly, despite dose modification and discontinuation rates being higher in TALAPRO-2 (44% and 8%, respectively) compared with PROpel (16% and 4%) and MAGNITUDE (13% and 2%), the benefit in radiographic (r)PFS was still maintained for the HRR-mutated patients (Table 1).

MANAGEMENT OF ANEMIA: KEY STRATEGIES

Prevention

As baseline anemia is a risk factor for developing grade ≥3 anemia during PARP inhibitor therapy,[37,38] and worsening anemia can occur fairly rapidly after initiation of a PARP inhibitor, it is important to assess for and treat anemia prior to initiation of PARP inhibitors (Figure 1). In the PROpel study, the median time to onset of anemia with olaparib plus abiraterone and prednisone was 1.9 months, and in the TALAPRO-2 trial, the median time to first onset of grade ≥3 anemia with talazoparib and enzalutamide was 3.3 months.[36,39] Resolution of anemia to a hemoglobin (Hb) level of 90–100 g/L is an appropriate threshold for initiating PARP inhibitor therapy, as these were the thresholds used in PARP inhibitor trials in mCRPC.[15,19,26] Baseline bloodwork should include complete blood count (CBC) with red blood cell (RBC) indices, blood smear morphology, serum B12, serum ferritin, transferrin saturation (TSAT), and creatinine to assess for anemia and common treatable etiologies. Patients should also be investigated and treated for any causes of bleeding as appropriate.

Iron deficiency is present in 40–60% of patients with cancer, with 20–30% of these cases having related anemia.[40,41] The majority of iron-deficient patients with cancer have functional iron deficiency, whereby iron availability is inadequate despite sufficient iron stores (TSAT <20%, serum ferritin >100 µg/L).[42] This is typically caused by hepcidin-driven iron sequestration as a result of inflammation. Absolute iron deficiency, indicating low iron stores, can also occur in cancer patients, often due to malnutrition or blood loss.[42]

There is minimal data on the long-term outcomes of iron supplementation on tumor growth;[43] however, it has been shown to improve patient quality of life and can be considered on a case-by-case basis in the context of optimizing patients for further treatment.[44] For absolute iron-deficiency anemia, a total dose of 1000–1500 mg intravenous (IV) iron may be sufficient to replenish stores. Oral iron supplementation can be trialed; however, is often poorly tolerated and regarded as less effective than IV iron. The IV iron preparations used will depend on local availability and clinical preference (Table 2). Ferric carboxymaltose, ferric derisomaltose, and low-molecular-weight iron dextran require fewer visits to achieve maximum dose, thus, are ideal options in this setting.[45]

The most notable risk of IV iron is infusion reaction, although major reactions with currently available products are rare.[46] As IV iron may promote inflammation and bacterial growth, it should not be given during an active infection.[47] Periodic monitoring of TSAT and ferritin levels should be performed in a patient receiving iron supplementation to monitor response and prevent iron overload and associated complications. There is some evidence supporting the benefit of IV iron monotherapy in functional iron-deficiency anemia,[48-51] and it may be trialed in select patients; however, there is insufficient evidence to recommend this approach on a routine basis, and possible detrimental effects of iron supplementation in patients with a high or normal ferritin level should be considered. Consultation with a hematologist is recommended to guide anemia management in this complex setting.

Approximately 15% of patients with solid tumors have B12 deficiency (serum B12 <200 pg/mL), with this incidence increasing with age.[52] Vitamin B12 stores can be replenished with 1000 mg B12 given as an intramuscular or subcutaneous injection weekly at initial diagnosis, and monthly thereafter.[53]

In about 10% of prostate cancer patients, chronic kidney disease (CKD) is present and can cause anemia through a reduction in erythropoietin synthesis, as well as an increase in hepcidin levels.[54,55] Patients with CKD may benefit from a referral to onconephrology to optimize renal function (Figure 1). RBC transfusions or erythropoietin-stimulating agents (ESAs) to manage anemia related to CKD should be selected based on an individualized risk/benefit analysis.[49,56]

Prior systemic therapies, including ADT, ARPIs, and docetaxel, as well as prior radiation therapy for the treatment of localized prostate cancer, can also cause transient anemia.[57-60] Pelvic radiation, in particular, leads to a larger bone-dose volume and has been associ-

Table 2. Comparison of IV iron products for the treatment of iron deficiency anemia

IV iron product	Dosage	Notes
Ferric gluconate	– 125 mg x 8 once-weekly doses (total dose=1000 mg)[68]	– Associated with increased severe infusion reactions[46] – IV infusion administered over 60 minutes – Multiple doses needed
Iron sucrose	– Various dosing schedules and administration times up to total dose of 1000 mg[a,69,70] – Single dose should not exceed 200–500 mg iron	– Multiple doses needed
Ferric carboxymaltose	– Total target dose varies by weight and baseline hemoglobin levels[a,71] – Single dose should not exceed 1000 mg or 15 mg/kg body weight – Maximum cumulative dose/week should not exceed 1000 mg (if >1000 mg is needed, doses should be given ≥7 days apart)	– Associated with transient hypophosphatemia, monitoring of phosphorous levels needed – One or two doses needed[c]
Low molecular weight iron dextran	– Total target dose varies by weight and baseline hemoglobin levels[a,72] – Single dose range: 100–2000 mg[b]	– Test dose required before first infusion (25 mg/0.5 mL over 5 minutes) with monitoring for reactions over 1 hour – Doses up to100 mg may be infused undiluted, maximum rate 50 mg/min – Single dose possible (infusion over several hours)[c]
Ferric derisomaltose	– Total target dose varies by weight and baseline hemoglobin levels[a,73] – Single dose should not exceed 1500 mg or 20 mg/kg body weight – Maximum cumulative dose/week should not exceed 1500 mg (if >1500 mg is needed, doses should be given ≥7 days apart)	– One or two doses needed
Ferumoxytol	– Total target dose varies by weight and baseline hemoglobin levels[a,74] – 1 or 2, 510 mg doses can be given (2–8 days apart)	– Impacts MRI interpretation – One or two doses needed

[a]See product monograph and relevant studies for specific dosing details. [b]Doses >100 mg are not indicated in the product monograph, but are common practice.[49] [c]Preferred when rapid recovery of iron stores is needed. IV: intravenous; MRI: magnetic resonance imaging.

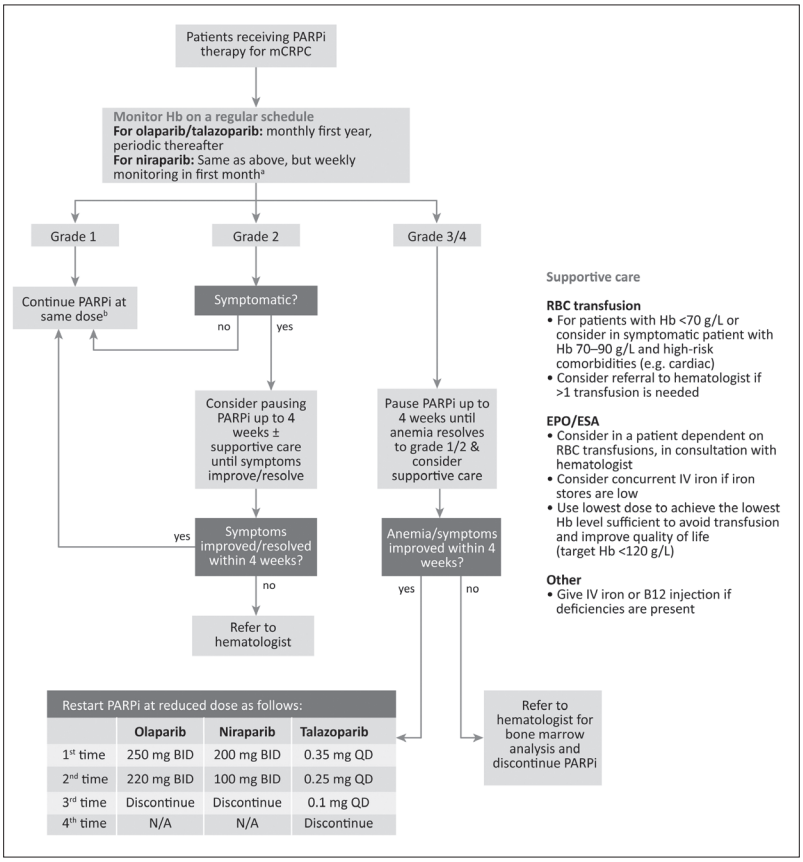

Figure 2. Management of anemia for patients with mCRPC receiving PARPi therapy. [a]Additional weekly monitoring was recommended in clinical trial protocol if grade ≥2 anemia occurs (until resolution to grade 1). Weekly monitoring up to 4 weeks was also recommended after re-initiating PARPi therapy following a dose delay. [b]Can consider one level dose reduction if grade 2 anemia is recurrent or symptomatic. BID: twice-daily; EPO: erythropoietin; ESA: erythropoietin stimulating agent; Hb: hemoglobin; IV: intravenous; mCRPC: metastatic castration-resistant prostate cancer; PARPi: poly [ADP-ribose] polymerase inhibitor; QD: once-daily; RBC: red blood cell.

ated with greater risk of hematologic toxicity in other solid tumors.[61] Acute anemia caused by prior therapy is expected to resolve by four weeks following the last treatment dose. RBC transfusion can be considered for patients with therapy-induced anemia who have Hb levels below the threshold for starting PARP inhibitor therapy (90 g/L) and who are symptomatic or have high-risk comorbidities (e.g., cardiac disease).

If the cause of anemia is unclear and it has not resolved within four weeks, referral to a hematologist is recommended. Unresolved cytopenias involving multiple cell lines may be an indicator of bone marrow infiltration, which causes anemia in approximately 30% of prostate cancer patients.[21] It is important to confirm bone marrow infiltration with a bone marrow biopsy, as this type of anemia may improve if patients respond to PARP inhibitors or other systemic therapy.

Other factors that may contribute to anemia risk that can optimized should be addressed as soon as a patient is deemed eligible for PARP inhibitor therapy. Adjustment or discontinuation of concomitant medications that contribute to blood loss, such as anticoagulants, non-steroidal anti-inflammatory drugs, and over-the-counter supplements, should be considered when safe and possible. To prevent dose-related toxicity effects, a patient's current medications should be reviewed for potential drug interactions that could increase the concentration of PARP inhibitors in the blood. Caution should be taken when co-administering medications that inhibit the primary metabolic pathways for each PARP inhibitor.[12-14] As olaparib and talazoparib are eliminated by renal clearance, dose adjustments must also be made for patients with renal impairment, as described in their product monographs.[12,13]

Monitoring

With the high frequency and early onset of anemia in PARP inhibitor trials, close monitoring of Hb levels in patients with mCRPC treated with PARP inhibitors is important, particularly in the first three months of treatment, when anemia is most likely to occur. For patients on olaparib or talazoparib, the product monographs recommend that CBCs be monitored monthly for the first 12 months of treatment, then periodically thereafter (Figure 1).[12,13]

The product monograph for niraparib recommends a similar monitoring schedule, with the exception of weekly monitoring of blood counts in the first month of treatment.[14] Monthly bloodwork should include the same tests performed to assess baseline anemia and its etiology. As PARP inhibitors are associated with an increased risk of myelodysplastic syndrome, a referral to a hematologist could be considered for cases of bicytopenia, or suspicion of dysplasia on the blood smear.

Dose interruptions and re-initiation

Dose modifications may be needed in the event of PARP inhibitor-induced anemia (Figure 2). Interruption of PARP inhibitor therapy is required if grade ≥3 anemia occurs (Hb <79 g/L) and may be considered for symptomatic grade 2 anemia (Hb 99–80 g/L). Once grade ≥3 anemia has resolved to grade 1/2 (or Hb ≥90 g/L) or symptoms leading to dose reductions have improved, PARP inhibitors can be re-initiated at a reduced dose, as described in the product monographs for each agent (Figure 2).[12-14] Re-escalation of dose is not recommended for patients with grade ≥3 anemia.

Although product monographs do not include guidance on how frequently CBCs should be assessed during a dose interruption due to anemia, protocols from

the clinical trials investigating niraparib suggest weekly monitoring until anemia is resolved and for 28 days after a reduced dose is initiated.[18,24]

Treatment discontinuation is recommended if anemia has not adequately resolved in four weeks despite supportive care, or in the event of multiple reoccurrences of grade ≥3 anemia where no further dose reduction is indicated.[13,14] An amendment in the TALAPRO-2 study protocol was made to allow a dose interruption of up to eight weeks for anemia to resolve; however, the median duration of dose interruption for anemia was not reported in trial publications.[25,36] Referral to a hematologist should be considered in cases where Hb levels have not recovered to ≥90 g/L after four weeks of dose interruption.

Supportive care during treatment

In all PARP inhibitor trials in mCRPC, anemia caused by PARP inhibitor therapy was managed with RBC transfusions, erythropoietin, or ESAs at the discretion of the investigator and local guidelines. International guidelines for the management of anemia in cancer recommend blood transfusions before ESAs to treat therapy-related anemia.[42,62] There is limited data on the optimal Hb threshold for RBC transfusions in the outpatient setting, thus, expert judgment and extrapolation of data from studies in hospitalized patients must be used.[63]

In general, RBC transfusions may be considered in a patient with Hb <70 g/L, although it may also be appropriate in patients with Hb 70–90 g/L if impaired oxygen delivery is suspected (e.g., tachycardia, hypotension, cardiac ischemia, syncope, pre-syncope).[64] This is consistent with the rates of RBC transfusion reported in the PARP inhibitor studies in mCRPC, where the majority of patients with grade ≥3 anemia received RBC transfusion (Table 1). Although blood transfusions allow for rapid improvement of anemia and associated symptoms, they have been linked to increased risk of thrombosis, cancer recurrence, and decreased survival, as well as pathogen transmission, transfusion reactions, iron or volume overload, and alloimmunization.[49]

Referral to a hematologist is recommended for patients requiring multiple RBC transfusions. The National Comprehensive Cancer Network (NCCN) and European Society for Medical Oncology (ESMO) guidelines for cancer-associated anemia recommend erythropoietin or ESAs in patients with non-myeloid malignancies undergoing antineoplastic therapy whose anemia cannot be appropriately managed with transfusions.[42,62] Given the risk of venous thromboembolism (VTE) and potentially poorer outcomes for patients receiving ESAs, this therapy should be reserved for patients requiring frequent transfusions, with the goal of maintaining the lowest Hb level sufficient to avoid transfusion and improve quality of life (target Hb <120 g/L).[42]

In clinical trials in mCRPC, 1–8% of patients receiving PARP inhibitors received erythropoietin or ESAs, reflecting a judicious use of these agents in patients with grade ≥3 anemia (Table 1). Patients should be informed of the benefits and risks of these agents, as well as the signs and symptoms of VTE. Contraindications to treatment include uncontrolled hypertension, inability to receive anti-thrombotic agents, history of pure red cell aplasia from past ESA therapy, and hypersensitivity to product components.[64] Serum ferritin should be monitored with Hb levels, as these agents require available iron. In many cases, IV iron has been shown to improve the efficacy of ESAs and can be given concurrently unless there is a risk of iron overload.[49]

CONCLUSIONS

Anemia represents a significant burden for patients with prostate cancer, causing fatigue, decreased ability to perform activities of daily living, decreased quality of life, and poor clinical outcomes. Given that patients with mCRPC frequently have anemia prior to initiation of PARP inhibitors, and that this increases the risk of developing grade ≥3 anemia while on PARP inhibitor therapy, a thorough assessment of anemia and determination of its cause are important before initiating PARP inhibitor therapy. Early recognition and effective management of anemia during PARP inhibitor therapy, particularly at the beginning of treatment, is imperative to keeping patients on adequate doses for longer.

Dose interruptions, dose reductions, and other supportive care measures, including RBC transfusion and ESAs, are important tools for managing anemia that occurs as a result of PARP inhibitor therapy. Since multiple factors can contribute to anemia and minimal data is available comparing how different anemia management strategies impact clinical outcomes for patients with mCRPC, decisions on how to manage anemia are best made by an experienced, multidisciplinary team, including hematologists, medical oncologists, urologists, and onco-nephrologists.

As PARP inhibitors have now become an important therapy for patients with HRR-mutated mCRPC and are continually being explored in earlier-line settings, it will be important to devise strategies to effectively manage toxicities of treatment, particularly anemia, in order to keep patients on treatment longer.

COMPETING INTERESTS: Dr. Hanna has received honoraria from Eisai and Pfizer and a research grant from Tolmar. Dr. O'Dwyer has received a research grant from EMD Serono and travel reimbursement from Pfizer. Dr. Hamilou has received honoraria for conferences from AAA, Astellas, AstraZeneca, EMD Serono/Pfizer, Merck, Seagen, and the Canadian Urological Association; and research funding from AstraZeneca. Dr. Noonan has received honoraria/support from Astellas, AstraZeneca, Bayer, BMS, EMD Serono, Janssen, Novartis, Pfizer, Tersera, and Tolmar. Ms. Doucette is employed by IMPACT Medicom Inc. Dr. Sridhar has received grant support from Bayer, EMD Serono, and Merck; consulting fees from Astellas, AstraZeneca, Bayer, Bicycle Therapeutics, BMS, Daiichi Sankyo, Eisai, EMD Serono, Ipsen, Janssen, Merck, Pfizer; honoraria from Bayer, EMD Serono, Knight Therapeutics, Merck, Novartis, and Pfizer; and travel support from Knight Therapeutics. The remaining authors do not report any competing personal or financial interests related to this work.

FUNDING: Funding was provided by Pfizer Canada to IMPACT Medicom Inc. to support medical writing services, including draft preparation, editing, and project coordination for this manuscript. The sponsors had no role in the design, execution, interpretation, or writing of the manuscript.

ACKNOWLEDGMENTS: The authors acknowledge the medical writing support provided by Sarah Doucette of IMPACT Medicom Inc., which was funded by Pfizer Canada.

REFERENCES

1. Brenner DR, Gillis J, Demers AA, et al. Projected estimates of cancer in Canada in 2024. *CMAJ* 2024;196:E615-23. https://doi.org/10.1503/cmaj.240095
2. Canadian Cancer Statistics Advisory Committee. Canadian Cancer Statistics 2018 [Report]. Toronto, ON: Canadian Cancer Society; 2018. Available at: cancer.ca/Canadian-Cancer-Statistics-2018-EN.pdf (April 25, 2025).
3. NCCN Clinical Practice Guidelines in Oncology (NCCN Guidelines®): Prostate Cancer Version 1.2025 - December 4, 2024. Available at: https://www.nccn.org/professionals/physician_gls/pdf/prostate.pdf (Accessed Feb 24 2025).
4. Barata PC, Leith A, Ribbands A, et al. Real-world treatment trends among patients with metastatic castration-sensitive prostate cancer: Results from an International Study. *Oncologist* 2023;28:780-9. https://doi.org/10.1093/oncolo/oyad045
5. O'Sullivan DE, Kolinsky MP, Shokar S, et al. A real-world observational study characterizing patients with advanced prostate cancer treated with or without androgen receptor-pathway-inhibitor therapies in Alberta, Canada. *Clin Genitourin Cancer* 2024;22:102115. https://doi.org/10.1016/j.clgc.2024.102115
6. Tannock IF, de Wit R, Berry WR, et al. Docetaxel plus prednisone or mitoxantrone plus prednisone for advanced prostate cancer. *N Engl J Med* 2004;351:1502-12. https://doi.org/10.1056/NEJMoa040720
7. Parker C, Nilsson S, Heinrich D, et al. Alpha emitter radium-223 and survival in metastatic prostate cancer. *N Engl J Med* 2013;369:213-23. https://doi.org/10.1056/NEJMoa1213755
8. Sartor O, De Bono J, Chi KN, et al. Lutetium-177-PSMA-617 for metastatic castration-resistant prostate cancer. *N Engl J Med* 2021;385:1091-103. https://doi.org/10.1056/NEJMoa2107322
9. Park JJ, Chu A, Li J, et al. Repeat next-generation sequencing testing on progression in men with metastatic prostate cancer can identify new actionable alterations. *JCO Precis Oncol* 2024;8:e2300567. https://doi.org/10.1200/PO.23.00567
10. Chung JH, Dewal N, Sokol E, et al. Prospective comprehensive genomic profiling of primary and metastatic prostate tumors. *JCO Precis Oncol* 2019;3. https://doi.org/10.1200/PO.18.00283
11. Ashworth A. A synthetic lethal therapeutic approach: poly(ADP) ribose polymerase inhibitors for the treatment of cancers deficient in DNA double-strand break repair. *J Clin Oncol* 2008;26:3785-90. https://doi.org/10.1200/JCO.2008.16.0812
12. PrTALZENNA® (talazoparib) capsules [product monograph]. Kirkland, Quebec: Pfizer Canada ULC; 2025.
13. PrLYNPARZA® (olaparib) tablets [product monograph]. Mississauga, Ontario: AstraZeneca Canada Inc; 2024.
14. PrAKEEGATM (niraparib and abiraterone acetate) tablets [product monograph]. Toronto, Ontario: Janssen Inc; 2023.
15. Saad F, Clarke NW, Oya M, et al. Olaparib plus abiraterone vs. placebo plus abiraterone in metastatic castration-resistant prostate cancer (PROpel): Final prespecified overall survival results of a randomized, double-blind, phase 3 trial. *Lancet Oncol* 2023;24:1094-108. https://doi.org/10.1016/S1470-2045(23)00382-0
16. de Bono JS, Mehra N, Scagliotti GV, et al. Talazoparib monotherapy in metastatic castration-resistant prostate cancer with DNA repair alterations (TALAPRO-1): An open-label, phase 2 trial. *Lancet Oncol* 2021;22:1250-64. https://doi.org/10.1016/S1470-2045(21)00376-4
17. De Bono J, Mateo J, Fizazi K, et al. Olaparib for metastatic castration-resistant prostate cancer. *N Engl J Med* 2020;382:2091-102. https://doi.org/10.1056/NEJMoa1911440
18. Smith MR, Scher HI, Sandhu S, et al. Niraparib in patients with metastatic castration-resistant prostate cancer and DNA repair gene defects (GALAHAD): A multicenter, open-label, phase 2 trial. *Lancet Oncol* 2022;23:362-73. https://doi.org/10.1016/S1470-2045(21)00757-9
19. Chi KN, Sandhu S, Smith MR, et al. Niraparib plus abiraterone acetate with prednisone in patients with metastatic castration-resistant prostate cancer and homologous recombination repair gene alterations: Second interim analysis of the randomized phase 3 MAGNITUDE trial. *Ann Oncol* 2023;34:772-82. https://doi.org/10.1016/j.annonc.2023.06.009
20. Fizazi K, Foulon S, Carles J, et al. Abiraterone plus prednisone added to androgen deprivation therapy and docetaxel in de novo metastatic castration-sensitive prostate cancer (PEACE-1): A multicenter, open-label, randomized, phase 3 study with a 2x2 factorial design. *Lancet* 2022;399:1695-707. https://doi.org/10.1016/S0140-6736(22)00367-1
21. Nalesnik JG, Mysliwiec AG, Canby-Hagino E. Anemia in men with advanced prostate cancer: incidence, etiology, and treatment. *Rev Urol* 2004;6:1-4.
22. Dai D, Han S, Li L, et al. Anemia is associated with poor outcomes of metastatic castration-resistant prostate cancer, a systematic review and meta-analysis. *Am J Transl Res* 2018;10:3877-86.
23. Clarke NW, Armstrong AJ, Thiery-Vuillemin A, et al. Abiraterone and olaparib for metastatic castration-resistant prostate cancer. *NEJM Evidence* 2022;1. https://doi.org/10.1056/EVIDoa2200043
24. Chi KN, Rathkopf D, Smith MR, et al. Niraparib and abiraterone acetate for metastatic castration-resistant prostate cancer. *J Clin Oncol* 2023;41:3339-51. https://doi.org/10.1200/JCO.22.01649
25. Agarwal N, Azad AA, Carles J, et al. Talazoparib plus enzalutamide in men with first-line metastatic castration-resistant prostate cancer (TALAPRO-2): A randomised, placebo-controlled, phase 3 trial. *Lancet* 2023;402:291-303. https://doi.org/10.1016/S0140-6736(23)01055-3
26. Fizazi K, Azad AA, Matsubara N, et al. First-line talazoparib with enzalutamide in HRR-deficient metastatic castration-resistant prostate cancer: The phase 3 TALAPRO-2 trial. *Nat Med* 2024;30:257-64. https://doi.org/10.1038/s41591-023-02704-x
27. Fizazi K, Piulats JM, Reaume MN, et al. Rucaparib or physician's choice in metastatic prostate cancer. *N Engl J Med* 2023;388:719-32. https://doi.org/10.1056/NEJMoa2214676
28. George DJ, Sartor O, Miller K, et al. Treatment patterns and outcomes in patients with metastatic castration-resistant prostate cancer in a real-world clinical practice setting in the United States. *Clin Genitourin Cancer* 2020;18:284-94. https://doi.org/10.1016/j.clgc.2019.12.019
29. Freedland SJ, Davis M, Epstein AJ, et al. Real-world treatment patterns and overall survival among men with metastatic castration-resistant prostate cancer (mCRPC) in the US Medicare population. *Prostate Cancer Prostatic Dis* 2024;27:327-33. https://doi.org/10.1038/s41391-023-00725-8
30. Abida W, Campbell D, Patnaik A, et al. Rucaparib for the treatment of metastatic castration-resistant prostate cancer associated with a DNA damage repair gene alteration: Final results from the phase 2 TRITON2 study. *Eur Urol* 2023;84:321-30. https://doi.org/10.1016/j.eururo.2023.05.021
31. Shiraishi C, Hirai T, Kaneda M, et al. Factors for the development of anemia in patients with newly introduced olaparib: A retrospective, case-control study. *Medicine* 2023;102:e34123. https://doi.org/10.1097/MD.0000000000034123
32. Farrés J, Llacuna L, Martin-Caballero J, et al. PARP-2 sustains erythropoiesis in mice by limiting replicative stress in erythroid progenitors. *Cell Death Differ* 2015;22:1144-57. https://doi.org/10.1038/cdd.2014.202
33. Hopkins TA, Ainsworth WB, Ellis PA, et al. PARP1 trapping by PARP inhibitors drives cytotoxicity in both cancer cells and healthy bone marrow. *Molec Cancer Res* 2019;17:409-19. https://doi.org/10.1158/1541-7786.MCR-18-0138
34. Shu Y, Ding Y, He X, et al. Hematological toxicities in PARP inhibitors: A real-world study using FDA adverse event reporting system (FAERS) database. *Cancer Med* 2023;12:3365-75. https://doi.org/10.1002/cam4.5062
35. Agarwal N, Azad AA, Carles J, et al. Talazoparib plus enzalutamide in men with metastatic castration-resistant prostate cancer: Final overall survival results from the randomized, placebo-controlled, phase 3 TALAPRO-2 trial. *Lancet* 2025;406:447-60. https://doi.org/10.1016/S0140-6736(25)00684-1

36. Azad AA, Fizazi K, Matsubara N, et al. Talazoparib plus enzalutamide in metastatic castration-resistant prostate cancer: Safety analyses from the randomized, placebo-controlled, phase 3 TALAPRO-2 study. *Eur J Cancer* 2024;213:115078. https://doi.org/10.1016/j.ejca.2024.115078
37. Armstrong AJ, Saad F, Oya M, et al. Association of baseline characteristics with adverse events (AEs) in the PROpel trial of olaparib (ola) plus abiraterone (abi) as first-line (1L) treatment for metastatic castration-resistant prostate cancer (mCRPC). *J Clin Oncol* 2024;42:e17030-e. https://doi.org/10.1200/JCO.2024.42.16_suppl.e17030
38. Mehra N, Fizazi K, de Bono JS, et al. Talazoparib, a poly(ADP-ribose) polymerase inhibitor, for metastatic castration-resistant prostate cancer and DNA damage response alterations: TALAPRO-1 safety analyses. *Oncologist* 2022;27:e783-95. https://doi.org/10.1093/oncolo/oyac172
39. Saad F, Armstrong AJ, Oya M, et al. tolerability of olaparib combined with abiraterone in patients with metastatic castration-resistant prostate cancer: Further results from the phase 3 PROpel tial. *Eur Urol Oncol* 2024;7:1394-402. https://doi.org/10.1016/j.euo.2024.03.006
40. Ludwig H, Müldür E, Endler G, et al. Prevalence of iron deficiency across different tumors and its association with poor performance status, disease status and anemia. *Ann Oncol* 2013;24:1886-92. https://doi.org/10.1093/annonc/mdt118
41. Luporsi E, Turpin A, Massard V, et al. Iron deficiency in patients with cancer: A prospective cross-sectional study. *BMJ Support Palliat Care* 2024;14:215-21. https://doi.org/10.1136/bmjspcare-2021-002913
42. Aapro M, Beguin Y, Bokemeyer C, et al. Management of anaemia and iron deficiency in patients with cancer: ESMO clinical practice guidelines. *Ann Oncol* 2018;29:iv96-110. https://doi.org/10.1093/annonc/mdx758
43. Beguin Y, Aapro M, Ludwig H, et al. Epidemiological and nonclinical studies investigating effects of iron in carcinogenesis—a critical review. *Crit Rev Oncol Hematol* 2014;89:1-15. https://doi.org/10.1016/j.critrevonc.2013.10.008
44. Gluszak C, de Vries-Brilland M, Seegers V, et al. Impact of iron-deficiency management on quality of life in patients with cancer: A prospective cohort study (CAMARA study). *Oncologist* 2022;27:328-33. https://doi.org/10.1093/oncolo/oyac005
45. Auerbach M, Henry D, Deloughery TG. Intravenous ferric derisomaltose for the treatment of iron deficiency anemia. *Am J Hematol* 2021;96:727-34. https://doi.org/10.1002/ajh.26124
46. Avni T, Bieber A, Grossman A, et al. The safety of intravenous iron preparations: systematic review and meta-analysis. *Mayo Clin Proc* 2015;90:12-23. https://doi.org/10.1016/j.mayocp.2014.10.007
47. Lapointe M. Iron supplementation in the intensive care unit: When, how much, and by what route? *Crit Care* 2004;8:S37. https://doi.org/10.1186/cc2825
48. Birgegård G, Henry D, Glaspy J, et al. A randomized noninferiority trial of intravenous iron isomaltoside vs. oral iron sulfate in patients with non-myeloid malignancies and anemia receiving chemotherapy: The PROFOUND trial. *Pharmacotherapy* 2016;36:402-14. https://doi.org/10.1002/phar.1729
49. Gilreath JA, Rodgers GM. How I treat cancer-associated anemia. *Blood* 2020;136:801-13. https://doi.org/10.1182/blood.2019004017
50. Makharadze T, Boccia R, Krupa A, et al. Efficacy and safety of ferric carboxymaltose infusion in reducing anemia in patients receiving chemotherapy for non-myeloid malignancies: A randomized, placebo-controlled study (IRON-CLAD). *Am J Hematol* 2021;96:1639-46. https://doi.org/10.1002/ajh.26376
51. Jang JH, Kim Y, Park S, et al. Efficacy of intravenous iron treatment for chemotherapy-induced anemia: A prospective, phase 2 pilot clinical trial in South Korea. *PLoS Med* 2020;17:e1003091. https://doi.org/10.1371/journal.pmed.1003091
52. Sottotetti F, Malovini A, Maccarone S, et al. Vitamin B12 status in hospitalised cancer patients: Prevalence and clinical implications of depletion and hypervitaminosis. *Clin Nutr ESPEN* 2024;63:585-94. https://doi.org/10.1016/j.clnesp.2024.07.017
53. Vitamin B12 Deficiency. StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025. Available at: https://www.ncbi.nlm.nih.gov/books/NBK441923/ (Accessed April 24, 2025).
54. Shahinian VB, Bahl A, Niepel D, et al. Considering renal risk while managing cancer. *Cancer Manag Res* 2017;9:167-78. https://doi.org/10.2147/CMAR.S125864
55. Launay-Vacher V, Ayllon J, Janus N, et al. Drug management of prostate cancer: Prevalence and consequences of renal insufficiency. *Clin Genitourin Cancer* 2009;7:E83-9. https://doi.org/10.3816/CGC.2009.n.029
56. Rashidi A, Garimella PS, Al-Asaad A, et al. Anemia management in the cancer patient with CKD and end-stage kidney disease. *Adv Chronic Kidney Dis* 2022;29:180-7.e1. https://doi.org/10.1053/j.ackd.2022.03.005
57. Warren AM, Grossmann M. Haematological actions of androgens. *Best Pract Res Clin Endocrinol Metab* 2022;36:101653. https://doi.org/10.1016/j.beem.2022.101653
58. Hicks BM, Klil-Drori AJ, Yin H, et al. Androgen deprivation therapy and the risk of anemia in men with prostate cancer. *Epidemiol* 2017;28:712-8. https://doi.org/10.1097/EDE.0000000000000678
59. Liu JM, Liu YP, Chuang HC, et al. Androgen deprivation therapy for prostate cancer and the risk of hematologic disorders. *PLoS One* 2020;15:e0229263. https://doi.org/10.1371/journal.pone.0229263
60. Wang Y, Probin V, Zhou D. Cancer therapy-induced residual bone marrow injury—mechanisms of induction and implication for therapy. *Curr Cancer Ther Rev* 2006;2:271-9. https://doi.org/10.2174/157339406777934717
61. Corbeau A, Kuipers SC, de Boer SM, et al. Correlations between bone marrow radiation dose and hematologic toxicity in locally advanced cervical cancer patients receiving chemoradiation with cisplatin: a systematic review. *Radiother Oncol* 2021;164:128-37. https://doi.org/10.1016/j.radonc.2021.09.009
62. NCCN clinical practice guidelines in oncology (NCCN guidelines®): Cancer- and chemotherapy-induced anemia - Version 2.2018 - November 21, 2017. Available at: https://oncolife.com.ua/doc/nccn/Cancer-and_Chemotherapy-Induced_Anemia.pdf (Accessed April 24, 2025).
63. Carson JL, Stanworth SJ, Guyatt G, et al. Red blood cell transfusion: 2023 AABB International guideline. *JAMA* 2023;330:1892-902. https://doi.org/10.1001/jama.2023.12914
64. Bloody Easy 5.1: Blood alternatives and transfusion reactions: A guide to transfusion medicine, fifth edition handbook [Internet]. Toronto: Ontario Regional Blood Coordinating Network; 2023. Available at: https://transfusionontario.org/en/bloody-easy-5-blood-transfusions-blood-alternatives-and-transfusion-reactions-a-guide-to-transfusion-medicine-fifth-edition-handbook/ (Accessed April 24, 2025).
65. Mateo J, Bono JSd, Fizazi K, et al. Olaparib for the treatment of patients with metastatic castration-resistant prostate cancer and alterations in *BRCA1* and/or *BRCA2* in the PROfound trial. *J Clin Oncol* 2024;42:571-83. https://doi.org/10.1200/JCO.23.00339
66. Hussain M, Mateo J, Fizazi K, et al. Survival with olaparib in metastatic castration-resistant prostate cancer. *N Engl J Med* 2020;383:2345-57. https://doi.org/10.1056/NEJMoa2022485
67. Fizazi K, Azad AA, Matsubara N, et al. Talazoparib plus enzalutamide in men with HRR-deficient metastatic castration-resistant prostate cancer: Final overall survival results from the randomized, placebo-controlled, phase 3 TALAPRO-2 trial. *Lancet* 2025;406:461-74. https://doi.org/10.1016/S0140-6736(25)00683-X
68. FERRLECIT® (sodium ferric gluconate complex) in sucrose injection [product monograph]. Laval, Quebec: Sanofi-aventis Canada Inc.; 2019.
69. PrVENOFER® (iron sucrose) Injection [product monograph]. Richmond Hill, Ontario: Fresenius Medical Care Canada Inc.; 2019.
70. Prpms-IRON SUCROSE Injection [product monograph]. Montreal, Quebec: PHARMASCIENCE INC.; 2020.
71. PrFERINJECT® (ferric carboxymaltose) Injection [product monograph]. Ottawa, Ontario: CSL Behring Canada, Inc.; 2024.
72. PrDEXIRON® (iron dextran) Injection [product monograph]. Mississauga, Ontario: Bellco Health Care Inc.; 2017.
73. PrMONOFERRIC® (ferric derisomaltose) for Injection [product monograph]. Kirkland, Quebec: Pfizer Canada ULC.; 2022.
74. PrFERAHEME® (ferumoxytol) for injection [product monograph]. Oakville, Ontario: Takeda Canada Inc.; 2015.

CORRESPONDENCE: Dr. Lilian Hanna, Department of Medical Oncology, Verspeeten Family Cancer Centre, London Health Sciences Centre, London, ON, Canada; hanna.lilian@gmail.com