A review of the patterns of docetaxel use for hormone-resistant prostate cancer at the Princess Margaret Hospital

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ABSTRACT

Background

Based on the TAX 327 phase III trial, docetaxel-based chemotherapy is the standard first-line treatment for hormone-resistant prostate cancer (HRPC); however, there is some heterogeneity in the use of this agent in routine clinical practice. The aim of the present study was to examine the patterns of docetaxel use in routine clinical practice at our institution and to compare them with docetaxel use in the TAX 327 clinical trial.

Methods

We conducted a retrospective chart review of HRPC patients treated with first-line docetaxel between 2005 and 2007 at the Princess Margaret Hospital.

Results

In the first-line setting, 88 patients with HRPC received docetaxel. The main reasons for initiating docetaxel were rising prostate-specific antigen (PSA, 98%) and progressive symptoms (77%). The PSA response rate was 67%; median time to response was 1.5 months, and duration of response was 6.8 months. Median survival was 15.9 months (95% confidence interval: 12.4 to 20.5 months). Patients received a median of 7 cycles of treatment, and the main toxicities were fatigue (35%) and neuropathy (24%). Post docetaxel, 36 patients received second-line treatment with a 22% response rate.

Conclusions

In routine clinical practice, HRPC patients received docetaxel mainly because of symptomatic disease progression. Overall response rates and toxicities were comparable to those in the TAX 327 trial. However, our patients received a median of only 7 cycles of treatment versus the 9.5 administered on trial, and survival was slightly shorter in our single-institution study. A larger prospective multicentre analysis, including performance status and quality-of-life parameters, may be warranted to determine if docetaxel performs as well in routine clinical practice as it does in the clinical trial setting.

KEY WORDS

Prostate cancer, hormone refractory, docetaxel, chemotherapy

1. INTRODUCTION

Prostate cancer is the most common cancer in men, with approximately 24,700 new cases diagnosed annually in Canada [1]. Patients presenting with localized prostate cancer are treated with curative intent by surgery or radiation, but up to 30% will relapse. Treatment then involves androgen-ablation therapies, with initial response rates of about 80%. Those responses are temporary, however, and all patients will eventually develop hormone-refractory prostate cancer (HRPC).

Hormone-refractory prostate cancer is defined as a rising PSA despite androgen ablation. It can manifest as one or more of

- increasing PSA,
- symptomatic progression,
- or radiologic evidence of progressive disease when serum testosterone is at castrate levels.

This condition is incurable, with a median life expectancy of 12–18 months. In the past, systemic treatments for HRPC, such as mitoxantrone and prednisone, offered palliative benefit, but no survival advantage [2]. Newer treatments with docetaxel and prednisone have now been shown to offer both palliative and survival benefits [3,4].

Docetaxel is a member of the taxane drug family, which causes cell death by inhibiting microtubule activity. On the basis of two large randomized clinical trials (Southwest Oncology Group 9916 and TAX 327),

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docetaxel is now considered the standard of care in the management of HRPC.

Southwest Oncology Group 9916 compared docetaxel plus estramustine with mitoxantrone plus prednisone and showed a median overall survival of 17.5 months in the docetaxel arm and 15.6 months in the mitoxantrone arm [hazard ratio (HR): 0.80; 95% confidence interval (CI): 0.67 to 0.77] [3]. The TAX 327 study compared two docetaxel–prednisone treatment arms (docetaxel administered weekly and docetaxel administered every 21 days) with mitoxantrone–prednisone. The final results showed that docetaxel every 21 days had a HR for death of 0.76 (95% CI: 0.62 to 0.94) with a 2.4-month improvement in survival (18.9 months vs. 16.5 months) compared with mitoxantrone [4]. Updated survival results confirmed that benefit, with an improvement over mitoxantrone of 3.1 months (19.2 months vs. 16.3 months) in the docetaxel-every-21-days arm [5]. On the basis of those studies, the U.S. Food and Drug Administration in May 2004 approved the use of docetaxel (75 mg/m^2 every 21 days) and prednisone as first-line therapy for metastatic HRPC. Health Canada granted approval in May 2005. Docetaxel–prednisone came into routine use at Princess Margaret Hospital in August 2005.

Despite docetaxel's approval for HRPC in the first-line setting, several aspects of its use remain heterogeneous and unclear: for example, when to initiate treatment, optimal duration of treatment, and appropriate treatment options after docetaxel failure. We used a chart review to specifically examine those factors as they relate to the use of docetaxel for the first-line treatment of HRPC in routine clinical practice.

2. METHODS

After approval was obtained from the institutional research board, we undertook a retrospective chart review of 88 patients with HRPC treated with first-line docetaxel chemotherapy from August 2005 to June 2007, with follow-up until February 2008. A list of eligible patients was obtained from the ambulatory pharmacy, which maintains a record of all chemotherapy administered according to drug and disease site. The electronic patient record (EPR) for each of these patients was reviewed.

Data collection included demographics, indications for treatment initiation and cessation, adverse effects, and number of cycles administered. Adverse effects were assessed from the EPRS, as recorded by the treating physician at each clinic visit. The cycles administered were obtained from the medication summary included in the EPR.

We compared our patient cohort with that of the TAX 327 study, recognizing that, because of the retrospective nature of the review, we could not exactly match all eligibility and response criteria. Eligibility criteria for TAX 327 required a Karnofsky performance status score of at least 60% and no prior treatment with chemotherapy except estramustine. Our study found it difficult to assess performance status; however, 24 patients who had received prior chemotherapy were excluded from our analysis.

In TAX 327, serum PSA was measured every 3 weeks, and response was defined as a reduction from baseline of at least 50% maintained for at least 3 weeks [6]. Progression of PSA was defined as an increase from nadir of at least 25% for men with no PSA response or at least 50% for all others. Our study looked at a more general clinical population, and so the PSA response criteria were less stringent. A response was defined as at least a 50% reduction from baseline PSA, and progression was defined as an increase of at least 50% from nadir PSA. Many of the patients assessed in our study did not have every-3-weeks PSA readings available, and responses were often not confirmed by a repeat PSA 3 weeks later.

Our study did not assess measurable lesions, because these generally were not meticulously recorded in the charts of clinic patients. Kaplan–Meier analysis was conducted for overall survival and median survival, and an estimate of the confidence intervals was made. Finally, we also assessed further lines of chemotherapy and the responses thereto.

3. RESULTS

Charts were reviewed for the 112 patients with HRPC who were treated with docetaxel between August 2005 and June 2007. The cut-off date for analysis was February 2008. The 24 men who had received prior chemotherapy with mitoxantrone were excluded from the review. Analysis was therefore limited to the 88 men who had received no prior chemotherapy. Median age was 71 years, and median baseline PSA was 107 ng/mL. Table I summarizes the patient characteristics.

3.1 Initiation of Docetaxel Treatment

In 86 patients (98%), rising PSA was an indication for starting chemotherapy treatment; in 36 patients (41%), a doubling time of 1 month or less was an indication. Symptoms were evident in 68 patients (77%), and 42 patients (48%) had radiologic evidence of progressive disease. In 17 asymptomatic patients without radiologic evidence of disease (19%), a rising PSA was the only indication for treatment (Table I).

3.2 Response Characteristics

The median number of cycles administered was 7 (range: 1–12 cycles). A PSA response was documented in 59 patients (67%). Median time to PSA response was 1.5 months; to PSA nadir, it was 4.1 months. Median duration of response was 6.8 months (range: 2–18.8 months). Kaplan–Meier survival analysis showed that median duration of survival from first drug use was 15.9 months (95% CI: 12.4–20.5 months), and

TABLE I Patient characteristics and indications for initiation of docetaxel chemotherapy at Princess Margaret Hospital

Characteristic	*Value*
Patients (*n*)	88
Age	
Median (years)	71
Range (years)	47–84
≥75 years [*n* (%)]	18 (20)
Reason for initiating chemotherapy [*n* (%)][a]	
Rising prostate-specific antigen (PSA)	86 (98)
Doubling time ≤1 month	36 (41)
Doubling time ≤2 months	9 (10)
Doubling time ≤3 months	7 (8)
Doubling time unknown	34 (39)
Radiologic evidence of progressive disease	42 (48)
Symptoms of progressive disease	68 (77)
Rising PSA only indication[b]	17 (19)
Symptoms at initiation of chemotherapy [*n* (%)]	68 (77)
PSA at baseline (ng/mL)	
Median	107
Range	0.5–6413
Follow-up (months)	
Median	13.5
Range	1.4–30.5
Status at last follow-up [*n* (%)]	
Living	30 (34)
Chemotherapy treatment with first-line docetaxel	
Still undergoing treatment	3 (34)

[a] Total exceeds 100% because more than one reason may apply in each case.
[b] Asymptomatic *and* no radiologic evidence.

1-year survival was 0.63 (95% CI: 0.52–0.72). Table II summarizes docetaxel treatment characteristics and response as measured by PSA level.

3.3 Adverse Effects

Table III summarizes adverse events related to chemotherapy. In our cohort, the most common adverse effects were fatigue (35%), sensory neuropathy (24%), peripheral edema (17%), and nail changes (14%). In the TAX 327 trial, those adverse events occurred at the following frequencies: fatigue, 53%; sensory neuropathy, 30%; peripheral edema, 19%; and nail changes, 30%. In 9 patients (10%), at least 1 chemotherapy infusion had to be delayed. The reasons for delay included neutropenia ($n = 4$, 2 of whom had febrile neutropenia episodes), anemia and thrombocytopenia ($n = 1$), infection ($n = 1$), and fatigue ($n = 1$); 2 patients were delayed to allow a treatment break (reason not specified).

TABLE II Treatment characteristics and response to docetaxel chemotherapy in 88 patients at Princess Margaret Hospital

Characteristic	*Value*
Response rate [*n* (%)]	59 (67)
Time to PSA response (months)	
Median	1.5
Range	0.7–13.4
Nadir PSA (ng/mL)	
Median	10.8
Range	0.1–338.9
Time to nadir PSA (months)	
Median	4.1
Range	0.7–14.2
Time to disease progression or duration of response (months)	
Median	6.8
Range	2–18.8
Survival (months)	
Median	15.9
Range	12.4–20.5
Cycles administered (*n*)	
Median	7
Range	1–12
One or more infusions delayed [*n* (%)]	9 (8)
Use of G-CSF [*n* (%)]	1 (1)
Reasons for stopping treatment [*n* (%)]	
Maximum disease response	23 (26)
Chemotherapy break	19 (22)
Disease progression	35 (40)
Drug toxicity	15 (17)
Missing data	4 (5)

[a] Reduction in serum PSA ≥50%.
PSA = prostate-specific antigen; G-CSF = granulocyte colony–stimulating factor.

3.4 Second-Line Chemotherapy

After progression, 36 of the 88 patients (41%) went on to receive second-line chemotherapy after a median chemotherapy-free interval of 4 months (range: 1–10 months). Of these 36 patients, 22% had a PSA response. Table IV summarizes the characteristics of, and response to, second-line chemotherapy. Table V summarizes post-docetaxel treatments, which included mitoxantrone for 32 patients (89%), who showed a

TABLE III Adverse effects during treatment of 88 patients at Princess Margaret Hospital

Adverse effect	*Frequency* [*n* (%[a])]
Fatigue	31 (35)
Neuropathy	21 (24)
Peripheral edema	15 (17)
Nail changes	12 (14)
Gastrointestinal (nausea, vomiting, diarrhea)	9 (10)
Taste changes	7 (8)
Febrile neutropenia	7 (8)
Tearing	5 (6)
Alopecia	5 (6)
Shortness of breath	5 (6)
Neutropenia	4 (5)
Mucositis	3 (3)
Myalgia	3 (3)
Thrombocytopenia	2 (2)
Anemia	2 (2)
Neutropenic sepsis	1 (1)
Dizziness	1 (1)
Allergic reaction	0

[a] Total exceeds 100% because more than one adverse effect may have been experienced in each case.

response rate of 19% and a median duration of response 4 months. The median number of second-line cycles administered was 3.5. Carboplatin–etoposide and 5-flourouracil–doxorubicin–cyclophosphamide were used in 1 patient each, with a PSA response in both cases.

3.5 Third- and Fourth-Line Therapy

Nine percent of patients (8/88) went on to receive third-line chemotherapy drugs: docetaxel ($n = 1$), phase I study drug ($n = 3$), phase II study drug ($n = 1$), and the combinations cisplatin–etoposide ($n = 2$) and 5-flourouracil–doxorubicin–cyclophosphamide ($n = 1$). One patient received a phase I drug in the fourth line.

4. DISCUSSION

In this review, we assessed the patterns of first-line docetaxel use for HRPC in routine clinical practice, and we compared our findings with the pattern of use in the landmark TAX 327 trial (Table VI). Characteristics such as age and baseline PSA were similar for both groups; however, not all criteria were available for comparison. For example, most patients in the 3-weekly docetaxel arm of TAX 327 had a Karnofsky performance-status score of 80% or better, indicating relatively good performance status, but because performance status is not meticulously documented in clinical charts, retrospective assessment was difficult.

TABLE IV Treatment and response characteristics for 36 patients who received second-line chemotherapy at Princess Margaret Hospital

Variable	*Value*
Baseline PSA (ng/mL)	
Median	141
Range	12–2491
Response rate[a] [*n* (%)]	8 (22)
Time to PSA response (months)	
Median	1.6
Range	0.3–3.9
Nadir PSA (ng/mL)	
Median	48
Range	2–71
Time to nadir PSA (months)	
Median	2.3
Range	0.7–7
Time to disease progression or duration of response (months)	
Median	4
Range	3–10
Cycles to disease progression (*n*)	
Median	5
Range	1–7
Cycles administered (*n*)	
Median	3.5
Range	1–9
Second-line treatment still underway [*n* (%)]	4 (11)
Reason for stopping treatment [*n* (%)]	
Chemotherapy break	3 (8)
Progression of disease	24 (67)
Adverse event	3 (8)
Missing data	6 (17)
Subsequent third-line therapy [*n* (%)]	8 (22)

[a] Reduction in serum PSA ≥50%.
PSA = prostate-specific antigen.

When to initiate docetaxel in HRPC patients remains an important question [7]. Our chart review found that symptomatic disease progression was the most common reason for initiating docetaxel; only 19% of

TABLE V Chemotherapy drugs and responses in the second-line setting at Princess Margaret Hospital

Chemotherapy	*Patients [*n *(%)]*	
	Receiving	*Responding*
Second-line chemotherapy	36	8 (22)
Drug		
Mitoxantrone	32 (89)	6 (19)
Cytarabine	2 (5)	0
FAC	1 (3)	1
Carboplatin–etoposide	1 (3)	1

FAC = 5-fluorouacil–doxorubicin–cyclophosphamide.

TABLE VI Baseline, treatment, and response characteristics of patients treated at Princess Margaret Hospital (PMH) and in the TAX 327 trial

Characteristic	*Patients*	
	PMH[a]	*TAX 327*[b]
Age		
Median (years)	71	68
Range (years)	47–84	42–92
≥75 years [*n* (%)]	20	20
Median serum PSA at baseline (ng/mL)	107	114
Cycles (*n*)		
Median	7	9.5
Range	1–12	1–11
≥50% Reduction in serum PSA		
Rate	67	45
Duration (months)		
Median	6.8	7.7
95% Confidence interval	2 to 18.8	7.1 to 8.6
Survival (months)		
Median	15.9	18.9
Range	12.4–20.5	17.0–21.2

[a] The 112 patients from the present review.
[b] From the docetaxel-every-3-weeks arm: 335 patients randomized; 291 patients evaluable for PSA response.
PSA = prostate-specific antigen.

patients were treated because of a rising PSA alone. Because docetaxel is not a curative treatment, waiting for development of symptoms or rapid disease progression may be a reasonable approach, and in this window, patients could be offered enrolment in clinical trials.

Another important question is the optimal duration of docetaxel treatment. In clinical practice, options include treating the patient until toxicity becomes unacceptable, until disease progresses, or until a few cycles beyond best response. The TAX 327 study selected a treatment duration of 10 cycles, with 9.5 cycles actually being administered. In our review, the median number of cycles administered was only 7. This key difference from the TAX 327 study may have relevance, particularly when informing patients about the expected duration of docetaxel treatment. Several reasons might explain this difference:

- Criteria for discontinuation may have been more strict on trial.
- Trial patients may have been keen to continue treatment despite early signs of progression.
- Clinic patients may have been more heterogeneous with respect to performance status or comorbidities and less able to tolerate chemotherapy.

A prospective study specifically collecting performance status and quality-of-life information would be required to directly address why fewer cycles were administered.

Despite receiving fewer cycles of chemotherapy, a good response rate of 67% was still achieved. This rate is higher than the rate seen in TAX 327, which is not surprising, because in the trial, a confirmatory PSA was required—something not routinely obtained in clinical practice [6]. Patients had a fairly short median time to PSA response of 1.5 months, and 4.1 months to PSA nadir, indicating that it is possible to know whether a patient is responding within 2–3 cycles of treatment. Although the response rate and the duration of response in our cohort were comparable to those of patients in the TAX 327 trial, median survival was slightly shorter than expected at 15.9 months compared with 18.9 months. Interestingly, a study by Howard *et al.* [8] also reported that, in terms of median survival, docetaxel did not perform as well in routine practice as it did in the clinical trial setting. We hypothesize that the lesser median survival may be attributable to a less-selected patient population (whose members might have been excluded from the clinical trial because of medical comorbidities such as cardiac conditions) or to the administration of fewer cycles of treatment. To adequately explain this finding, a larger prospective study is required.

The most common adverse events (fatigue, sensory neuropathy, peripheral edema, and nail changes) were similar to those seen in the TAX 327 trial. Neutropenia was recorded in 13% of patients, with febrile neutropenia, which is more clinically significant, described in 8% of our cohort (compared with 3% in TAX 327). Neutropenic sepsis was seen in only 1%, and use of granulocyte colony–stimulating factor in 1%. The fear of neutropenic complications may be one of the factors that limits use of docetaxel in HRPC, but these relatively low rates of neutropenic sepsis are reassuring. Among our patients, 17% discontinued docetaxel because of adverse effects, compared with

11% among TAX 327 patients, suggesting that, even in an unselected population, docetaxel remains a fairly well-tolerated regimen.

For patients progressing on or after docetaxel, there is currently no accepted standard second-line treatment for HRPC [9,10]. In our study, 41% of patients received second-line therapy after a median chemotherapy-free period of 4 months; in the TAX 327 study, 23% of patients received second-line therapy. These numbers are significant, considering that the efficacy of second-line treatment is not well established and that this patient population is frequently elderly and frail. It does, however, reflect the increasing use of second-line therapy in HRPC and the need for effective options [9]. Our study provides further evidence for this trend, with 22% of patients going on to receive third-line therapy.

5. CONCLUSIONS

Based on the TAX 327 randomized trial, docetaxel-based chemotherapy is the standard first-line treatment for patients with HRPC; however, there is some heterogeneity in its use in routine clinical practice, which may vary from that in the TAX 327 trial. We found that most HRPC patients received docetaxel because of a combination of symptoms and disease progression. The median time to response was 1.5 months (2–3 cycles), and the duration of response was 6.8 months. Overall response rates and toxicities were comparable to those in the TAX 327 trial, except that our patients received a median of only 7 cycles of treatment versus 9.5 on trial, and that survival was slightly shorter in our single-institution study. A larger prospective multicentre analysis, including performance status and quality-of-life parameters, may be warranted to determine whether docetaxel performs as well in routine clinical practice as it does in the clinical trial setting, and to better understand post-docetaxel treatment approaches and response rates.

6. CONFLICT OF INTEREST DISCLOSURE

The authors declare that no financial conflict of interest exists.

7. ACKNOWLEDGMENTS

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