CLINICAL STUDY

Safety and Efficacy of Prostatic Artery Chemoembolization for Prostate Cancer—Initial Experience

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ABSTRACT

Purpose: To evaluate outcome of prostatic artery chemoembolization for patients with prostate cancer (PCa).

Materials and Methods: This single-center prospective cohort study was conducted between August 2013 and July 2016 in 20 patients with PCa who underwent chemoembolization. Mean patient age was 67.5 years ± 6.4. Gleason score was 6–10, and staging was T2N0M0. Fifteen patients refused prostatectomy and 5 wanted to stop hormonal therapy because of side effects. For chemoembolization, *Chelidonium majus* mother tincture 1 mL was slowly injected into the prostatic arteries. Docetaxel 1 mL and 150–300 μm Embosphere (Merit Medical Systems, Inc, South Jordan, Utah) microspheres 0.5 mL were thoroughly mixed, and the mixture was slowly injected by the same route. Embolization of prostatic arteries was finished with 150–300 μm Embosphere microspheres. Technical success was defined as bilateral prostatic artery embolization. Biochemical failure was defined as prostate specific antigen (PSA) decrease to < 2 ng/mL followed by recurrence when PSA increased to > 2 ng/mL within 1 month after success.

Results: Technical success was 80.0% (16/20 patients). Biochemical failure was 18.7% (3/16 patients). There was 1 short-term biochemical recurrence at 4 months and 2 midterm recurrences (12–18 months). Biochemical success at 12–18 months was 62.5% (10/16 patients). Adverse events (31.3%) included a small area (2 cm^2) of bladder wall ischemia, which was removed by surgery (n = 1); transient acute urinary retention (n = 1) and urinary urgency (n = 1) for 1 week; sexual dysfunction (n = 2), which completely recovered after 10 and 12 months, respectively.

Conclusions: Prostatic artery chemoembolization allowed a biochemical response in patients with localized PCa and is a promising treatment.

ABBREVIATIONS

BF = biochemical failure, BR = biochemical recurrence, BS = biochemical success, CI = confidence interval, EBRT = external-beam radiotherapy, IPSS = International Prostate Symptom Score, PAE = prostatic artery embolization, PCa = prostate cancer, PSA = prostate specific antigen, RP = radical prostatectomy

Prostate cancer (PCa) is the most frequent cancer in Europe in men > 70 years old and the most commonly diagnosed nonskin cancer in men in the United States, second only to lung cancer in annual fatality rate, with a lifelong risk for diagnosis currently estimated at 15.9% (1,2). Each year, > 200,000 new cases are diagnosed with approximately 1 in every 6 US men affected by the disease. Histology studies from autopsy series show that approximately 33% of men 40–60 years old have PCa (3). The incidence of PCa increases with age and reaches 75% in men > 85 years old (4).

Radical prostatectomy (RP) is a curative treatment for localized PCa. Other curative treatments are external-beam radiotherapy (EBRT) and brachytherapy. Alternative options to RP include hormonal therapy, watchful waiting, and active surveillance (5–7). Prostatic artery embolization (PAE) in patients with benign prostatic hyperplasia has shown good results at short-term, midterm, and long-term follow-up (8–17). These results led us to consider treating PCa by prostatic artery chemoembolization.

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EDITORS' RESEARCH HIGHLIGHTS

- This retrospective study reports prostatic artery chemoembolization in 20 patients with prostate cancer with Gleason 6–10, stage T2N0M0 disease who refused surgery or wished to cease hormonal therapy. Embolization with *Chelidonium majus* mother tincture, Lipiodol, and bland microspheres was possible in 16 of 20 patients.
- Midterm biochemical success (prostate specific antigen < 2 ng/mL) was achieved in 10 patients (62.5%), and gland volume reduction was seen in most cases.
- Adverse events included transient sexual dysfunction, urinary retention and urgency, and 1 case of surgically managed bladder wall ischemia.
- Patients with prostate cancer who may wish to avoid surgery or may be unsuitable surgical candidates may benefit from cytoreductive therapies. This study demonstrates feasibility and early success supporting a potential role for embolotherapy. Prostate cancer embolization bears further study under prospective structured protocols.

Chelidonium majus is a plant extract that was approved by the German Commission E Monographs for use in humans; it is devoid of significant side effects on normal cells but is cytotoxic to cancer cells and has been used experimentally in Austria with success for a vast array of cancers (18–20). Docetaxel, a chemotherapy agent currently used for prostatic cancer, is also made of a plant extract that is submitted to a small chemical transformation that turns it into a semisynthetic agent (21). Therefore, a treatment protocol was designed based on prostatic artery chemoembolization and using *Chelidonium majus* plus docetaxel mixed with Embosphere (Merit Medical Systems, Inc, South Jordan, Utah) microspheres for patients with PCa without extracapsular invasion who refused or discontinued conventional treatments. In this study, the preliminary results and initial efficacy of a new, highly conservative treatment for PCa with chemoembolization using a combination of *Chelidonium majus* plus docetaxel mixed with Embosphere microspheres are reported.

MATERIALS AND METHODS

This single-center prospective study was conducted from August 2013 to July 2016 with approval by the institutional review board and written informed consent obtained from every patient. The study included men $\geq$ 50 years with biopsy-proven diagnosis of stage T2N0M0PCa without extracapsular extension who refused other treatment or who were intolerant to the side effects of hormonal therapy and wanted to discontinue it and who had sexual dysfunction or accepted the risk of developing sexual dysfunction after treatment. Patients with advanced atherosclerosis or tortuosity of the iliac and prostatic arteries on computed tomography (CT) angiography that could prevent selective catheterization of both prostatic arteries or secondary renal insufficiency owing to prostate enlargement or active prostatitis were excluded. If prostatitis was present, antibiotics were given, and biopsy was performed after only cure of prostatitis. All patients were informed of the procedure and the experimental nature of it; the possible benefits and risks of the available treatment options; their option to freely change to other therapies at any time; and the possibility that the treatment might cause bowel and urinary problems, sexual dysfunction, and infertility.

Prostate specific antigen (PSA) levels were evaluated before chemoembolization and then monthly for 6 months after chemoembolization, then every 3 months for 2 years, and then every 6 months thereafter. At each evaluation, if there was no decrease in serum PSA level to < 2 ng/mL at 1 month after prostatic artery chemoembolization, if there was recurrence of PSA > 2 ng/mL, or if there was an increase of PSA $\geq$ 2mg/mL above the nadir PSA, the patients would be advised to change to 1 of the standard therapies. The following parameters were evaluated before chemoembolization and every 6 months after the procedure: International Prostate Symptom Score (IPSS), quality-of-life question from the IPSS, International Index for Erectile Function, prostate volume by transrectal ultrasound, and peak urinary flow rate and postvoid residual volume assessed by uroflowmetry (13). CT angiography of prostatic arteries was performed before every chemoembolization, whereas nuclear medicine bone scan (scintigraphy) was performed in patients with PSA $>$ 10 ng/mL. Multiparametric magnetic resonance (MR) imaging using T2-weighted, diffusion-weighted, and perfusion imaging was performed before and 6–12 months after chemoembolization. Multiparametric MR imaging has been used for detecting locally recurrent PCa after EBRT (21). Suspicious nodules were marked and followed before and after chemoembolization (**Figs 1a–d**, **2a–d**).

Chemoembolization

Patients were started on an acid-suppressing drug once daily (omeprazole 20 mg [Bluepharma, Coimbra, Portugal]), a nonsteroidal anti-inflammatory drug twice daily (naproxen 1,000 mg [Naprosyn; Roche, Basel, Switzerland]), and an antibiotic twice daily (levofloxacin 500 mg [Ciprofloxacin; Jaba, Santiago de Besteiros, Portugal]) 1 day before the procedure and continued for 1 week after chemoembolization (9–11). The patients were admitted to the hospital 2 hours before the procedure. Before chemoembolization, nitroglycerin 150 μg was injected into the prostatic arteries. During embolization, an analgesic (metamizole 2 g [Nolotil; Boehringer Ingelheim, Ingelheim, Germany]) and an anti-inflammatory (ketorolac trometh-amine 30 mg [Toradol; Roche) were administered intravenously. Pethidine (meperidine 0.5 mg [Labesfal, Campo de Besteiros, Portugal]) was given subcutaneously. Chemoembolization was performed by interventional radiologists

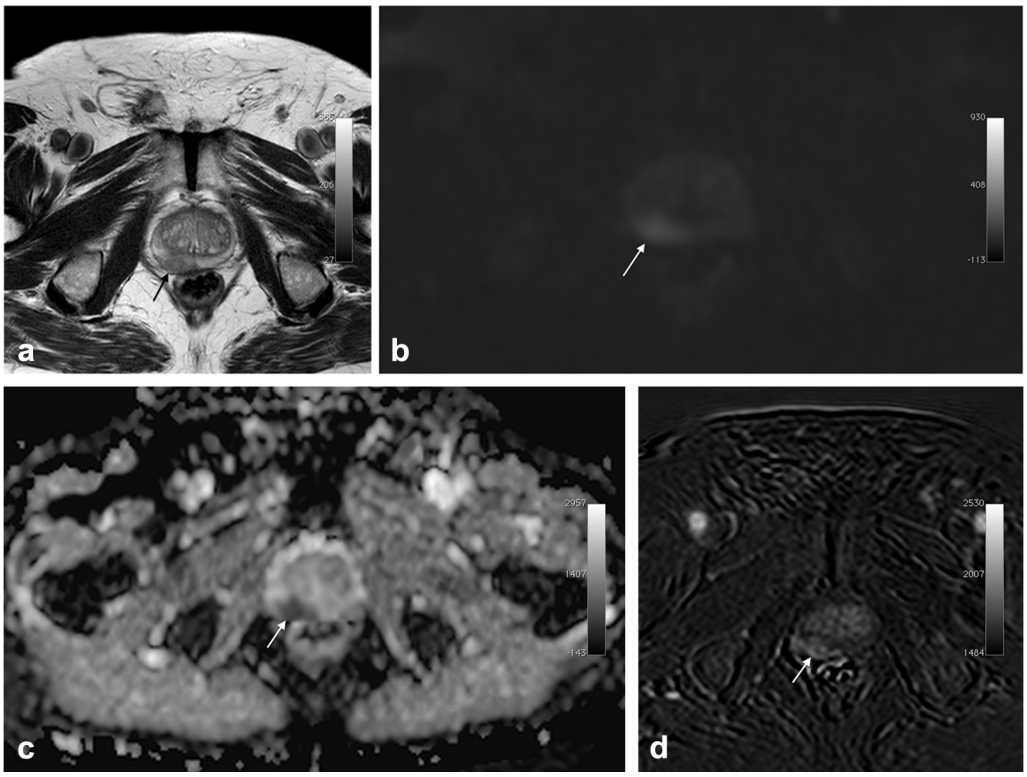

Figure 1. **(a–d)** MR imaging of the prostate before chemoembolization depicting a PCa (Gleason 4 + 4; PSA of 12.2 ng/mL) in the right peripheral zone of the prostate (arrows). **(a)** Hypointense on axial T2-weighted image. **(b)** Hyperintense with diffusion restriction (b1400). **(c)** Hypointense on apparent diffusion coefficient map. **(d)** Hypervascular nodule with perfusion imaging.

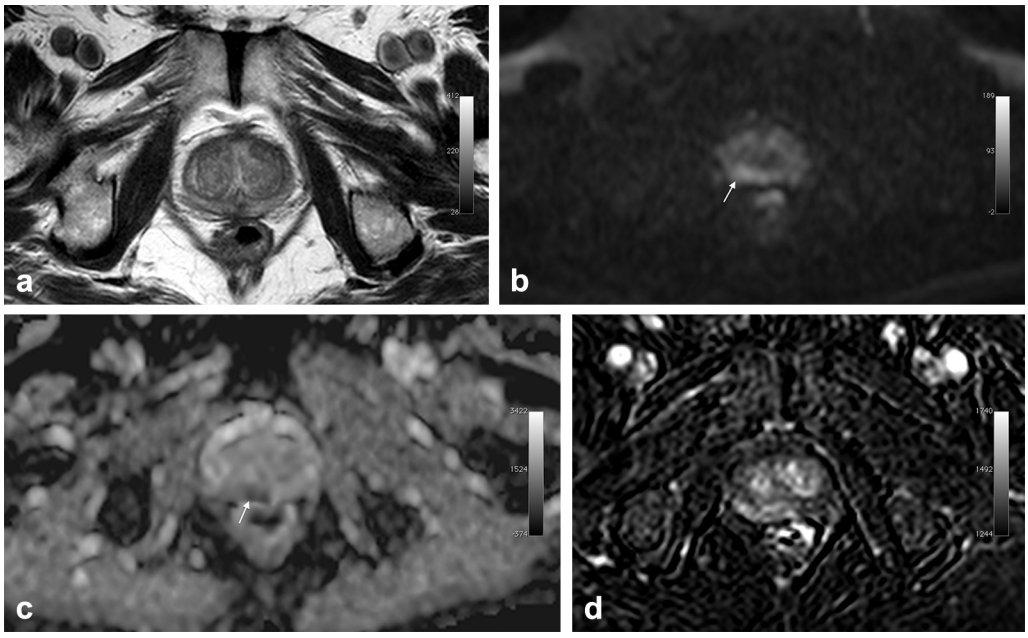

Figure 2. MR imaging of the prostate 6 months after chemoembolization in the same patient shown in Figure 1. The PCa decreased in size and is depicted only with diffusion imaging. **(a)** PCa is not seen on axial T2-weighted image. **(b)** Hyperintense with diffusion restriction (b1400). Arrow indicates PCa. **(c)** Hypointense on apparent diffusion coefficient map. Arrow indicates PCa. **(d)** PCa is not seen with perfusion imaging. PSA at 6-month follow-up decreased to 0.5 ng/mL.

with 8 (J.P., T.B.) and 4 (N.V.C., L.F.) years of experience with PAE. Embolization was performed under local anesthesia through a unilateral approach, usually the right femoral artery. A 5-F catheter (PPC; Merit Medical Systems, Inc) was introduced into the right femoral artery to catheterize the left hypogastric artery and its anterior division. Digital subtraction angiography of the anterior division of the hypogastric artery was performed in the ipsilateral

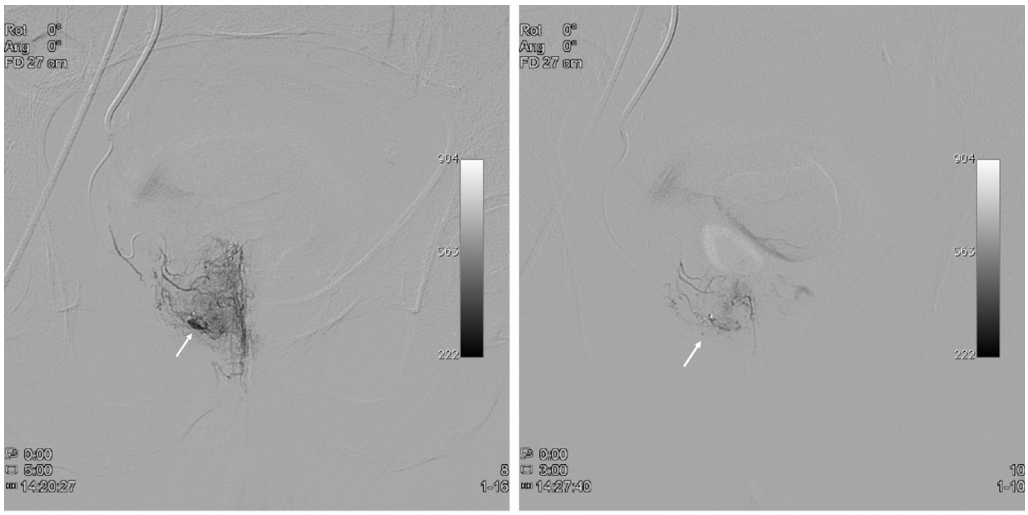

Figure 3. **(a, b)** Selective digital subtraction angiography of the right prostate artery (arrows) in the same patient shown in **Figure 1** before **(a)** and after **(b)** chemoembolization.

oblique projection to visualize the anatomy of the prostatic arteries. The prostatic vessels were selectively catheterized with a 2.4-F coaxial microcatheter (Maestro; Merit Medical Systems, Inc) as previously described (**Fig 3a**, **b**) (9–16). Cone-beam CT was performed in the last 6 patients (**Fig 4a–c**). To avoid nontargeted embolization, important collaterals to the bladder, rectum (middle rectal), or penis (accessory pudendal arteries) were occluded with coil embolization.

For chemoembolization, the prostatic artery was initially evaluated with a contrast injection to determine the optimal volume of contrast medium to be used. This volume was then repeated for the contrast injection, usually 0.5–1.0 mL, and was injected very slowly into the prostatic artery. After a 3-minute waiting time, the docetaxel solution was slowly injected into the prostatic arteries under fluoroscopy and stopped when reflux toward the origin of the prostatic artery was observed. The solution of docetaxel was prepared as follows: docetaxel (Docetaxel Accord; Accord Healthcare Ltd, North Harrow, United Kingdom) 1 mL was placed in a 3-mL Luer-Lok syringe with 150–300 μm Embosphere microspheres 0.5 mL. This syringe was connected to another similar syringe via a 3-way stopcock. The mixture was passed 20 times through both syringes. The embolization of the prostatic arteries was finished with 150–300 μm Embosphere microspheres. The endpoint of chemoembolization was considered when all arterial branches that supplied the prostate were completely occluded with full stasis of flow within those branches. Angiography was performed 3 minutes after the chemoembolization procedure (**Fig 3a**, **b**).

Outcome Measures

Technical success was defined as chemoembolization of the prostatic arteries on both sides; otherwise, the procedure would be considered a technical failure. Procedure duration, fluoroscopy duration, and radiation dose were recorded. Patients were asked to rate their pain severity on a scale from 0 (no pain) to 10 (worst pain possible) during the procedure, at discharge, and the next morning. Adverse events were classified according to the Society of Interventional Radiology (SIR) criteria. Adverse events were considered serious if patients needed prolonged hospitalization, repeat hospital admission, or surgery (22).

Biochemical success (BS) was defined as a PSA value at 1 month after chemoembolization < 2 ng/mL in patients with no previous treatment for PCa or a PSA level less than or equal to the value before chemoembolization but < 2 ng/mL in patients receiving hormonal therapy; otherwise, a case would be considered a biochemical failure (BF) (23). Biochemical recurrence (BR) was defined as a PSA increase > 2 ng/mL after BS. BR is not equivalent to clinical failure; however, it is an appropriate early endpoint in many clinical trials (24–26). Short-term BR was considered when there was BR between 1 and 12 months, and midterm BR was considered when BR occurred between 12 and 18 months. As chemoembolization of the prostate is a new procedure, this definition of biochemical failure has not been proposed before; however, it is similar to the definition used after EBRT. Following EBRT, a rising PSA level ≥ 2 ng/mL above the nadir PSA is the most reliable sign of recurrent disease (23,24).

Statistical Analysis

Summary statistics are presented as mean ± SD. The 95% confidence intervals (CIs) for proportions are exact binomial. Change from baseline in study variables was tested with nonparametric Wilcoxon signed rank test. All tests are 2-tailed. Differences were considered statistically significant when $P < .05$. Stata 11 (Stata Corp LLC, College Station, Texas) was used for statistical analysis.

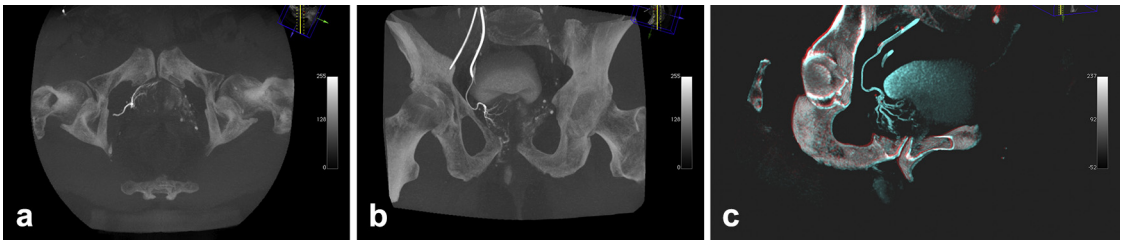

Figure 4. Cone-beam CT images after selective catheterization of the right prostate artery in the same patient shown in Figure 1. Axial **(a)**, coronal **(b)**, and sagittal **(c)** reformatted images.

RESULTS

This study included 20 patients with biopsy-proven PCa refusing or intolerant to standard therapy. Fifteen patients had refused radical prostatectomy previously recommended to them, and 5 patients chose to discontinue hormonal therapy owing to the side effects they experienced. The hormonal therapy was bicalutamide 150 mg/d for an average of 1.5 y. Before hormonal therapy, all patients received EBRT. Age range of patients was 54–78 years (mean 67.5 y ± 6.4), Gleason score was 6 in 8 patients and 7–10 in 12 patients, and PSA was 0.02–23.41 ng/mL (mean 6.87 ng/mL ± 6.66). All patients were T2N0M0. Two patients had a bladder catheter. Table 1 shows the baseline data of the study population.

All patients were treated as outpatients. The procedure duration was 60–120 minutes (median 82.6 min). Fluoroscopy duration was 6–45 minutes (median 16.8 min). The radiation dose was 700–4,200 dGy-cm^2 (median 2,853 dGy-cm^2). Patients were discharged 4–6 hours after chemoembolization. The mean pain score during chemoembolization was 3.5 (range, 2–9). The mean pain score at the time of discharge was 1.5 (range, 0–4) and the morning after chemoembolization was 0.8 (range, 0–2). Follow-up duration was 12 months for 2 patients and 18 months for 18 patients.

Chemoembolization was technically successful in 16 of 20 patients (80.0%). In the other 4 patients (20%), the technical failures were due to atherosclerotic changes of both the iliac and the prostatic arteries. Among the 4 patients with technical failure, 2 patients underwent unilateral chemoembolization. Two patients with technical failure underwent RP, 1 opted for brachytherapy, and the fourth patient refused any other treatment.

Efficacy is summarized in Table 2. Of the 16 patients, 13 with technical success (81.3%; 95% CI, 54.4%–96.0%) had BS. In these patients, mean PSA decreased from 5.21 ng/mL ± 6.17 (range, 0.02–23.41 ng/mL) before chemoembolization to 0.81 ng/mL ± 0.60 (range, 0.02–1.8 ng/mL) at 1 month after prostatic artery chemoembolization (P = .002). In the 9 patients who were not receiving hormonal therapy before chemoembolization, mean PSA decreased from 7.31 ng/mL ± 6.40 (range, 2.54–23.41 ng/mL) before chemoembolization to 1.04 ng/mL ± 0.57 (range, 0.28–1.80 ng/mL) after 1 month (P = .008). In the remaining 4 patients who were receiving hormonal therapy, mean PSA before chemoembolization was 0.48 ng/mL ± 0.42 (range, 0.02–0.87 ng/mL) and 1 month later was 0.28 ng/mL ± 0.26 (range, 0.02–0.60 ng/mL) (P = .09). In these 4 patients, the PSA did not increase the month after chemoembolization, although hormonal therapy was stopped 15 days before the embolization procedure (Table 3).

There were 3 BFs and 1 BR at 3 months with PSA of 2.91 ng/mL. Therefore, in the group of patients with technical success, the number of patients with BS at short-term follow-up before 12 months was 12 of 16 (75%; 95% CI, 47.6%–92.7%). At midterm follow-up (12–18 months), there were 2 additional BRs, both at 12 months, with PSA increased to 2.5 ng/mL and to 5.62 ng/mL, respectively; therefore, at midterm, 10 patients had BS (62.5%; 95% CI, 35.4%–84.8%). Chemoembolization was repeated 6 months after the initial treatment in 2 of the patients with BF, achieving BS. Chemoembolization was also repeated in 1 of the patients with BF at 12 months whose PSA decreased

Table 1. Baseline Patient Characteristics

Variable	Mean	SD	Range
Age, y	67.5	6.4	54–78
PSA, ng/mL	6.87	6.66	0.02–23.41
PV, mL	63.4	56.9	12–266
IPSS	16.3	9.0	2–32
QoL	4.05	1.64	1–6
Qmax, mL/min	15.9	8.3	3.9–38.0
PVR, mL	88.5	119.3	0–446
IIEF	12.7	8.1	9–24
Gleason score	7.30	1.38	6–10

IIEF = International Index for Erectile Function; IPSS = International Prostate Symptom Score; PSA = prostate specific antigen; PV = prostate volume; PVR = postvoid residual; Qmax = peak urinary flow; QoL = quality of life.

Table 2. Biochemical Response Rates over Time after Chemoembolization

Biochemical Success	Number	%	95% CI	
Initial	13	81.3	54.4	96.0
Short-term	12	75.0	47.6	92.7
Midterm	10	62.5	35.4	84.8

CI = confidence interval.

Table 3. Treatment Results

Patient	Previous Treatments	PAE Date	Gleason	Before	PSA After									
					1	2	3	4	5	6	9	12	18	24
1	None	8/22/2013	4+5	14.02	7.61	10.4	2.4	1.72	1.7	1.76		1.76	1.8	
2	None	1/30/2014	5+5	5.54		1.06	0.65	0.55	0.6	Bladder Ischemia/ prostatectomy	0.41	0.44	0.3	
3	None	12/3/2015	4+5	11.43	8.52	10.24								
4	None	12/28/2015	4+5	23.41	1.8	1.6	1.7	1.9	1.8	1.9	1.9	1.9	1.3	
5	EBRT + HT	10/30/2014	3+4	0.22	0.13	0.05	0.04	0.05	0.1	0.07	0.08		0.09	
6	None	7/9/2015	3+3	9.00	1.67	1.67	1.67	1.91	1.9	1.9	1.93	HT 2.5	2.5	
7	None	7/9/2015	3+4	4.68	0.77	1.19		1.6	1.6	1.5	1.5	1.6	1.7	
8	EBRT + HT	7/16/2015	3+3	0.81	0.6	0.37	0.37	0.39	0.5	0.48	0.39	0.39	0.4	
9	None	7/30/2015	4+3	3.48	0.28	0.14	1.15		1	1.05		HT 5.62	2.3	
10	None	12/3/2015	4+4	19.39	8.93	8.93								
11	EBRT + HT	12/17/2015	3+3	0.02	0.02	0.02			0	0.01	0.01	0.01	0.01	
12	None	1/7/2016	3+4	8.22	1.64	1.53	1.73	1.76	1.8	1.76	1.7	1.29	1.2	
13	EBRT + HT	1/7/2016	3+3	0.87	0.31	0.6	0.58	1.4	1.4	1.72	1.8	1.8	1.9	
14	None	2/5/2016	3+3	5.25	1.05	0.77	H 2.91	6.14		2.1				
15	None	2/11/2016	3+3	3.68	0.33	0.21	0.31	0.33	0.3	0.35		0.32		
16	None	7/2/2016	3+3	2.54	0.77	0.67		0.66		0.68	0.65	0.6		

EBRT = external-beam radiotherapy; HT = hormone therapy; PAE = prostatic artery embolization; PSA = prostate specific antigen.

Table 4. Change in Biochemical Parameters and Scale Scores in Patients with Midterm Biochemical Responses

Variable		Mean	SD	Change	95% CI		*P*
PSA, ng/mL	Baseline	5.88	6.87	−4.68	−9.28	−0.07	.013
	18 months	1.20	0.96				
PV, cm^3	Baseline	84.0	71.6	−29.6	−56.2	−3.03	.013
	18 months	54.4	40.6				
IPSS	Baseline	12.2	7.24	−3.44	−7.03	0.14	.075
	18 months	8.78	4.49				
QoL	Baseline	3.30	1.64	−0.90	−1.82	−0.20	.06
	18 months	2.40	1.26				
Qmax, mL/min	Baseline	17.7	9.6	8.45	−12.0	28.9	.44
	18 months	26.1	27.8				
PVR, mL	Baseline	93.9	150.3	−10.0	−140.2	120.2	.78
	18 months	83.9	77.5				
IIEF	Baseline	14.1	9.8	−4.1	−12.6	4.36	.28
	18 months	10.0	7.0				

CI = confidence interval; IIEF = International Index for Erectile Function; IPSS = International Prostate Symptom Score; PSA = prostate specific antigen; PV = prostate volume; PVR = postvoid residual; Qmax = peak urinary flow; QoL = quality of life.

from 5.62 ng/mL to 2.3 ng/mL. The other 3 patients with BF were treated by EBRT followed by hormonal therapy.

Prostate multiparametric MR imaging performed 12 months after chemoembolization in the 12 patients with short-term success showed a decrease in volume in most patients, which was also shown by ultrasound. In patients with midterm responses, prostate volume decreased 29.4%, and PSA decreased 52.6%. These changes were statistically significant ($P = .013$ in both counts). In patients with midterm responses, there was an improvement, although not statistically significant, in lower urinary tract symptoms, as evaluated by the IPSS ($P = .075$) and IPSS quality-of-life question ($P = .06$), as well as in peak urinary flow rate, postvoid residual volume, and International Index for Erectile Function. Table 4 shows the change in study variables from baseline to 18 months in patients with midterm biochemical responses.

Among the 16 patients with technical success, the Gleason score was 6 in 7 patients, and multiparametric MR imaging did not show any change before or after the procedure. In 3 patients whose Gleason score was ≥ 7, control multiparametric MR imaging showed a $> 50\%$

reduction in tumor size and ischemia (Fig 2a–d) after chemoembolization.

Adverse events included a small area of bladder wall ischemia that was removed by surgery in 1 patient 6 months after chemoembolization. There was 2 cm^2 of intraluminal necrotic tissue attached to the bladder wall base, without involvement of the urethra or ureters. PSA before chemoembolization was 5.54 ng/mL and in the following months the PSA decreased to 1.06 ng/mL, 0.65 ng/mL, 0.55 ng/mL, and 0.6 ng/mL at the time of cystoscopy. Prostatectomy was performed simultaneously, and the histologic examination did not show any tumor despite the presence of a Gleason score 4 + 5 tumor before chemoembolization. Two patients developed sexual dysfunction that completely recovered after 10 and 12 months, respectively. One patient had acute urinary retention treated with a bladder catheter for 1 week, and another patient had transient urinary urgency lasting for a week.

DISCUSSION

A patient with a recent localized PCa faces a very frustrating choice of treatments (26). He may choose to delay treatment until symptoms appear (watchful waiting); to be followed under close surveillance and start treatment if and when the cancer progresses (active surveillance); or to finally undergo RP, radiotherapy, or hormonal therapy (5,27–29). The patient's quality of life may change with these different therapies (30). About two thirds of men with a diagnosis of PCa have a low PSA and/or low-risk disease. Despite these facts, almost 90% of men undergo early intervention, surgery, or radiotherapy (5,28,29). However, prostatectomy is associated with increased risk of urinary incontinence and erectile dysfunction (5). The benefit of RP concerning survival is greater in men < 65 years old and in patients with intermediate-risk PCa. Several randomized clinical trials comparing RP with watchful waiting in patients with localized PCa did not show a statistically significant difference between surgery and watchful waiting in terms of overall survival (5,7,29,30).

The rationale for chemoembolization was based on the results of PAE for benign prostatic hyperplasia (8–16). Initially, the plant extract *Chelidonium majus*, which has been shown not to affect normal cells while having an anticancer effect, mixed with a vascular blocker was used (17–19). Although tolerance was perfect, despite the extremely high concentrations attained by the product in the prostatic tissue, it seemed possible to obtain even better results in terms of efficacy. This led us to start adding a new therapeutic combination of docetaxel and 150–300 μm Embosphere microspheres.

The technical failure rate was high because the definition was different from the commonly adopted definition of technical failure in PAE for benign prostatic hyperplasia; that is, technical failure was considered when bilateral chemoembolization was not achieved. It is important to periodically evaluate PSA values after treatment. The significant increase of PSA levels following any local therapy (ie, BR) is also important after chemoembolization (31,32). Although many patients in this study had a low-risk T2N0M0 tumor, RP had been recommended in 15 patients. Although multiparametric MR imaging is performed only after a significant increase of PSA following any treatment for PCa, in this study it was performed 1 year after chemoembolization. In patients whose Gleason score was ≥ 7 and who did not have previous hormonal therapy, multiparametric MR imaging was able to show the tumor before chemoembolization and its reduction in volume and vascularity after chemoembolization. However, in 6 patients with a Gleason score of 6, multiparametric MR imaging did not show any suspicious focal changes before or after chemoembolization.

This study has several important limitations. The embolization protocol has not been previously tested or validated. Not all patients had embolization of both central gland and peripheral gland prostate arteries. The small sample size, the short-term follow-up data, and the absence of a control group limit conclusions. Prostate biopsy was not routinely performed during follow-up, which would be important to show the effect of chemoembolization in malignant cells. The single patient in whom a histologic examination of the prostate was performed did not have any sign of malignancy, despite the presence of a Gleason score 4 + 5 tumor before chemoembolization. Also, the reported complication rate of 31% (5 of 16) warrants caution, although 2 complications were transient adverse events that lasted 1 week, and 2 were sexual dysfunction that completely recovered after 10 and 12 months, respectively. The major complication rate after most treatments for PCa is much higher (5).

In conclusion, the results of a prostatic artery chemoembolization protocol with follow-up to 18 months are provided. Prostatic chemoembolization can safely be repeated, as it was in 3 patients, if the prostatic arteries are suitable and can be followed, without increased risk, by any other conventional treatment for PCa. The other 3 patients with BF were treated by hormonal therapy.

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