How I do it: prostate cryoablation (PCry)

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DA SILVA RD, JAWORSKI P, GUSTAFSON D, NOGUEIRA L, MOLINA W, KIM FJ. How I do it: prostate cryoablation (PCry). *Can J Urol* 2014;21(2): 7251-7254.

Prostate cryoablation (PCry) is a well-established minimally invasive therapy for the treatment of prostate cancer. Unfortunately, PCry still carries the stigma of a high rate recto-urethral fistula procedure but with the advent of argon/helium gas technology, urethral warmer and high quality transrectal ultrasound imaging, complications decreased and efficacy increased. The Denver Health Medical Center's technique in prostate cryoablation is described as follows.

Key Words: prostate cryoablation, technique

Introduction

James Arnott first described cryotherapy to treat cancer in England, between 1845 and 1951. Initially cryotherapy treated breast and cervix cancers, reporting diminution of tumor size, reduction in drainage and amelioration of pain.[1] In 1964 Gonder et al developed a modified apparatus and probes suitable for transurethral due to advancement of technology and equipment improving the safety and outcomes of freezing of the prostatic disease.[2] In the past two decades a resurgence of this technique has been observed this procedure. The development of intraoperative ultrasonography and the use of thermo sensors reduced drastically the damage to surrounding tissues, especially the urinary rhabdosphincter.[3,4]

The cryoablative site is characterized by two zones; a central zone where total coagulative necrosis is evident, and a peripheral zone where varying degrees of cellular death and injury are present.[3] The mechanisms of cellular destruction and damage include both direct, immediate physical damage to cells, and more delayed cell death due to local hypoxia and apoptosis.[3]

Prostate cryoablation is not only an accepted minimally invasive option for the treatment of localized prostate cancer, but it can also be a treatment option for recurrence after radiation therapy.[4,5] The adoption of prostate cryoablation to treat prostate cancer has been expanding worldwide in developed and developing countries due to comparable oncological outcomes and a less invasive procedure, when compared to open radical prostatectomy.[4,6,7]

Accepted for publication March 2014

A video is available online at http://www.canjurol.com/how-i-do-it.php

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Cheetham et al reported the 10 year outcome of prostate cryotherapy after primary and salvage cryoablation of the prostate achieving overall 87% of disease-specific survival, including the early cryotherapy technology and patients with high D'Amico risk.[8] The 10 year biochemical free survival for patients treated with prostate cryoablation classified by the D'Amico risk stratification was reported to be 80.56%, 74.16% and 45.54% for low, moderate and high risk groups respectively.[9] Interestingly, older patients (> age of 75 years) have similar oncological outcomes compared to younger man without increased morbidity.[10]

Surgical technique

Preoperative care and patient position

Fleet enema should be administered the night prior to the procedure and the morning of the procedure to decrease ultrasound visualization artifacts. Preoperative intravenous antibiotics (cephalosporin or quinolone) should be given prior to the procedure. The patient should be placed in the lithotomy position and perineal hair should be clipped and the most dependent part of the scrotum elevated and secured to a 12 o'clock position with a silk suture. All pressure points must be well padded, and knee and pelvic joints well rested and supported.

Placement of cryoprobes

Using the brachytherapy plate with 0.5 cm spacing between probes and transrectal ultrasound (TRUS) guidance, the prostate must be re-measured with special attention to the rhabdosphincter and the bladder neck. Temperature probes are placed in areas of interest (Dennonvillliers, rhabdosphincter ± neurovascular bundles) using the sagittal view on TRUS.

Denver Health's modification

The TRUS probe balloon is filled with 30 cc-40 cc of sterile saline to compress the prostate base upwards so cryoprobes are placed from the bottom up. By inflating the TRUS balloon, the prostate is held up by the cryoprobes increasing the prostate to the rectal wall space (0.3 cm to 0.9 cm).

Position of cryoprobes

TRUS sagittal and transverse views allow the surgeon to check the position of the cryoprobes so the urinary system is not perforated. This step is confirmed with flexible cystoscopy by examining the urethra, prostatic fossa, and retroflexion to visualize the bladder neck. At this point, a supra-pubic catheter can be placed under direct visualization.

Placement of urethral warmer

The Seldinger technique is used to place a urethral warmer over a super stiff guide wire pre-placed at the end of flexible cystoscopy. The urethral warmer is kept constant at 42.0°C. Operating room staff must check the level of the irrigation bag regularly throughout the procedure to ascertain integrity of the tubing system and constant temperature.

Freezing of cryoprobes

A total of two cycles of active freezing is recommended. The correct sequence of freezing begins by starting the freezing from the top down so that the hypoechoic ice ball formation can be monitored in real-time by TRUS. Freezing from the bottom-up obscures visualization of the prostate due to the expansion of the ice ball. The freezing cycle must be considered for 6-8 minutes to achieve optimal killing zone, and the maximum expansion of the ice ball will occur in 8 minutes. The ice ball formation can be controlled by decreasing expansion rate and maintaining temperature without ablating undesired areas.

Active thawing

Active thawing occurs after each freezing cycle until the tissue can be visualized entirely in the TRUS. The second thawing can be abbreviated and passive thawing may begin when the cryoprobe's temperature reaches > 10.0°C and the probes are removed. Once the cryoprobes are removed, the perineum must be pressed with a sterile sponge to aid hemostasis. The suture securing the scrotum and the urethral warmer can be removed prior to extubation. Follow up is done within 1 week for a voiding trial and a surgical site check.

Results

In 1964, Gonder et al treated prostate cancer using liquid nitrogen and free hand placement of cryoprobes without the high resolution ultrasound probes, urethral warmer, or control mechanisms of ice ball expansion. The results were suboptimal and dramatic. Complications resulted in severe urinary incontinence, urethral sloughing, and recto-urethral fistulae (RUF). The advent of high-resolution transrectal ultrasound and the use of temperature probes in the cryotherapy system were beneficial. Real time monitoring of ice

TABLE 1. **Patients demographics, perioperative data and postoperative outcomes**

Patients demographics	Average	Std Dev	% of total patients
Number of patients	182		
Age (years)	63.44	7.06	
Prostate size (cc)	38.58	18.11	
PSA ng/dL (median)	11.83	10.7	
D'Amico risk groups			
Low risk	53		29.1
Moderate risk	69		37.9
High risk	36		19.8
Perioperative data			
Operative time (min)	80.7	30.0	
Lymphadenectomy	85		46.7
Hospital stay (days)	1.38	0.75	
Postoperative outcomes			
PSA nadir, ng/dL (50th percentile)	0.40		
Biochemical recurrence	15		8.2
Pathologic recurrence	12		6.6
Lymph node metastasis	11		6.0
Urethral-rectal fistula	4		2.1

ball formation and temperature near vital anatomical landmarks is pivotal to prevent surgical complications (urinary incontinence and RUF).[11] The use of argon gas for freezing and helium gas for thawing permitted a significant reduction in the diameter of the cryoprobes (17-gauge), creating a less invasive method of curative prostate cancer therapy. In 1996, the American Urological Association (AUA) recognized cryoablation as a therapeutic option for prostate cancer. In 2008, the AUA established the Best Practice Statement about the use of cryosurgery for patients with clinically localized prostate cancer. This established cryosurgery as a therapeutic option for radiotherapy-recurrent and organ-confined prostate cancer patients.

From 2004 to November 2013, the prostate cryoablation program at Denver Health Medical Center included 182 patients, Table 1. Retrospective analysis of our data demonstrated the mean: age of 63.4 years (SD: 56.4 years-70.5 years), PSA 11.8 ng/mL (SD: 1.13 ng/mL-22.5 ng/mL) and D'Amico risk groups of 29%, 38% and 20% for low, moderate and high risk. Our median operative time is 80.7 (SD: 51 minutes-111 minutes) from those 47% received laparoscopic pelvic lymphadenectomy and lymph nodes metastasis was found in 6% of the patients. The average hospital stay is 1.4 days (SD: 0.63 days-2.1 days). On follow up, the biochemical recurrence was 15 patients (8.2%) using the ASTRO-Phoenix criteria with confirmed pathological recurrence in 12 patients (6.6%). This technique yielded four patients (2.2%) with recto-urethral fistula (RUF).

Historically, rates of RUF ranged from 0% to 3%.[12] Large series such as the COLD registry have yielded RUF rates that ranged from 0.4% in 2008[13] to 1.2% in 2013.[14] Recently, the rate of RUF increased to 1.2% when more aggressive higher grade prostate cancer was treated with cryoablation.[14] Moreover, one must be critical of this particularly large series since it is dependent on voluntary input of different hospitals including academic and community hospitals with different cryotherapy technology.

Contemporary prostate cryotherapy offers the patient a minimally invasive treatment option with low morbidity, minimal blood loss, short hospital stay, and comparable biochemical-free survival rates in comparison to other treatment options.[15]

Reports comparing quality-of-life among open prostatectomy, robotic prostatectomy, cryoablation, and brachytherapy as treatments for localized prostate cancer demonstrated that cryotherapy was associated with improved urinary function.[16] Urinary incontinence may vary from 0%-2.9% after primary whole gland prostate cryoablation.[4,10,14] Erectile function (EF) proves challenging after cryoablation, but 40% of patients may restore sexual function within 36 months post surgery.[17] On-demand use of erectile aids could contribute to the rehabilitation of postoperative EF and reduce sexual complaints after prostate cryosurgery.[4,17]

Cohen et al reported a 10 year follow up post prostate cryoablation for localized prostate cancer and found a 56% biochemical disease-free survival rate in patients using the ASTRO-Phoenix definition. Using the D'Amico risk stratification the 10 year biochemical disease-free survival rate was reported as 81%, 74% and 46% for low, moderate and high risk groups respectively.[9]

Conclusion

Cryoablation is an accepted minimally invasive surgical option for curative treatment of localized prostate cancer and should be considered for salvage therapy for patients with local recurrence of the disease. PCry offers equal or higher rates of urinary continence when compared to open and robotic prostatectomy. The risk of recto-urethral fistula with this procedure has significantly decreased with the advent of new technology (argon and helium gas versus liquid nitrogen). Moreover, long term disease-specific survival is comparable to other organ-sparing treatment modality for prostate cancer. □

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