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PERITONEAL DIALYSIS UNIVERSITY FOR SURGEONS: A PERITONEAL ACCESS TRAINING PROGRAM

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♦ ***Background:*** **A functioning catheter is vital to the success of peritoneal dialysis (PD). Catheter complications related to the insertion procedure remain a major hindrance to PD utilization. Most catheters are placed by surgeons. Suboptimal catheter outcomes appear to be related to inadequate training and experience during surgical residency and the absence of educational opportunities to remedy this deficit once the surgeon is in practice.**

♦ ***Objective:*** **The aim of this report is to describe a 1-day comprehensive surgeon training program in PD access surgery and to convey the results of the first 7 courses.**

♦ ***Methods:*** **Needs assessment data served as the foundation for formulating course objectives and content. A disease-based approach to PD was taken to provide both didactic instruction and laboratory exercises. Surgical simulators permitted skills development for each key task in catheter placement. Educational outcomes were measured with pre- and post-tests, course evaluation, and follow-up survey.**

♦ ***Results:*** **Seven courses were attended by 134 surgeons with an average faculty to participant ratio of 1:4 during hands-on laboratory sessions. Pre- and post-testing demonstrated a class-average normalized educational gain of 50%. On a 5-point Likert scale, the course was scored highly on 14 areas of evaluation with average responses ranging from 4.4 to 4.9. A follow-up survey conducted a mean of 28 months after the programs revealed significantly increased utilization of all 10 course-targeted PD access skills. Participants gave mean scores of 4.6 for improved confidence in case management and 4.4 for better catheter outcomes.**

♦ ***Conclusions:*** **A comprehensive 1-day peritoneal access training course can produce long-term self-assessed improvement in surgical management and PD catheter outcomes.**

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KEY WORDS: Surgical education; surgical skills course; simulation training; learning gain; peritoneal catheter placement; peritoneal dialysis.

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The success of peritoneal dialysis (PD) as renal replacement therapy depends upon a functional peritoneal catheter. After infectious complications, catheter mechanical problems are the most common reasons for PD failure, accounting for approximately 20% of patient transfers to hemodialysis during the first year (1–3). Most catheter malfunctions can be attributed to procedural errors and/or omission of recognized best practices and proactive techniques during catheter implantation (4,5). The incidence of catheter failure is probably much higher than reported since patients who never start therapy because of catheter dysfunction from the outset are not included in dialysis service databases (1,2). In addition, it is unknown what proportion of catheters removed for infectious complications is due to poor technique in subcutaneous tunnel construction and unfavorable exit-site location. Undoubtedly, lack of familiarity with appropriate catheter rescue and salvage procedures for mechanical and infectious complications further contributes to the catheter loss rate.

The majority of PD catheters are placed by surgeons, amounting to almost 80% of catheter insertion procedures performed in the United States (6). Disappointing outcomes are thought to be due to inadequate training and experience in catheter insertion methods. In a national survey of US surgery training programs, Wong *et al.* found that 82% of programs reported training residents in PD catheter placement (7). During their surgical residency, 23% of trainees placed ≤ 2 catheters and 61% placed ≤ 5 catheters. Only 13% of residents placed > 10 catheters. Low PD utilization by nephrologists seemed to be a major driving factor for insufficient PD access experience because of low procedure volumes. It is likely, however, that frequent catheter complications resulting from inadequate surgical instruction discouraged nephrologists from making PD referrals. Fewer referrals prevent surgical trainees from ever gaining sufficient experience in catheter placement, perpetuating a vicious cycle of unacceptable outcomes, dissatisfaction with PD, and low PD utilization.

After surgical residency, practicing surgeons tend to perform procedures the way they were trained and are cautious about adopting a new technique that departs significantly from their previous practice or skill level without seeking some form of additional training. For practical reasons, they

cannot afford to return to an apprenticeship environment to learn a new procedure and ethical concerns make it objectionable to use the operating room as a venue for acquisition of new technical skills. Therefore, there is a definite need for an educational program beyond the period of residency training to assist practicing surgeons to overcome the deficits in their peritoneal access surgery instruction. A complete educational experience would necessarily include both cognitive and skills development, recognizing that a hands-on opportunity is crucial for surgeons to learn new techniques (8).

The purpose of this report is to describe a 1-day comprehensive surgeon training program in PD access surgery comprised of both didactic sessions and a hands-on laboratory and to communicate the results of the first 7 courses.

MATERIALS AND METHODS

Wake Forest University School of Medicine and the International Society for Peritoneal Dialysis (ISPD) jointly sponsored the development of a 1-day training course entitled Peritoneal Dialysis University for Surgeons (PDUS). The course planning committee identified educational needs that underlie professional practice gaps through study of ISPD guidelines and literature review. This needs assessment data served as the foundation for formulating the course objectives listed in Table 1. Creation of course content was in compliance with the Accreditation Council for Continuing Medical Education Standards for Commercial Support: Standards to Ensure Independence in Continuing Medical Education (CME) Activities (9).

The curriculum was devised to provide both didactic instruction and laboratory exercises. Lecture topics were selected to give participants an in-depth background in medical and economic aspects of PD as renal replacement therapy and surgical fundamentals for providing and maintaining peritoneal access. A hands-on laboratory experience was developed to teach specific skills in performing access procedures. High-fidelity human torso simulators were constructed for this purpose so that attendees could learn and practice critical tasks in catheter placement. To assure sufficient hands-on exposure in the laboratory, 20 registrants were considered optimal course size to permit a group of 4 individuals to rotate through each of 5 faculty-supervised surgical skill stations. Course materials produced for distribution to the attendees included a syllabus with a printout of lecture slides, a laboratory guide, a surgeon's guidebook to PD access procedures, and a digital video disc demonstrating implantation techniques for PD catheters. Wake Forest University School of Medicine, the accrediting CME provider, designated this educational activity for a maximum of 8.25 American Medical Association Physician's Recognition Award Category 1 Credits. Courses were funded by participants' registration fees and unrestricted educational grants from industry and the ISPD.

TABLE 1
Course Objectives

At the end of this course participants will be able to:
• Explain the medical and economic benefits of promoting appropriate use of peritoneal dialysis as renal replacement therapy
• Understand the basic concepts of how peritoneal dialysis works
• Perform preoperative assessment to determine the most suitable peritoneal catheter type, insertion site, and skin exit site based upon the specific needs of the patient
• Apply best demonstrated practices in patient and procedure preparation for peritoneal dialysis catheter implantation
• Perform advanced laparoscopic techniques to prevent catheter tip migration and omental entrapment
• Execute proper insertion of extended 2-piece peritoneal catheters to provide upper abdominal or presternal skin exit sites
• Carry out correct tunneling of the catheter to the exit site with application of appropriate dressings or embed the external limb of the catheter
• Employ appropriate rescue and salvage procedures for mechanical and infectious peritoneal catheter complications

A written test comprised of 20 questions was created to measure knowledge level before and upon completion of the course. An evaluation form was prepared to appraise the participants' perception of the effectiveness of the curriculum content and their overall satisfaction with how the course was conducted. The course evaluation employed a 5-point Likert scale with 1 being very low and 5 representing very high. A follow-up survey was designed to assess changes in the participants' surgical practices as a result of attending the course. All previous course participants received an invitation to participate in the online survey. The survey plan included 3 reminder invitations at 2-week intervals to non-responders.

Effectiveness of the educational experience as a whole was determined using pre-test and post-test scores to calculate class-average normalized educational gain (g). This metric is the ratio of the whole group's performance to the maximum achievable improvement and is expressed mathematically as:

$$g = (\%\ \text{post-test} - \%\ \text{pre-test}) / (100 - \%\ \text{pre-test}) \times 100$$

A value of $g \geq 30\%$ was accepted as indicating an effective educational intervention (10–12).

Contingency table analyses were performed with chi-squared test for unpaired data and McNemar's test for paired data. Analyses were performed with GraphPad Prism version 6.02 and GraphPad QuickCalcs (GraphPad Software, San Diego, CA, USA). All results were considered significant at $p < 0.05$.

RESULTS

Seven PDUS courses were conducted at major cities across the United States from November 2010 through June 2014. A total of 134 surgeons from private and academic practices attended the course, averaging 19.1 surgeons per event. The course pre-test was completed by 131 participants (97.8%) with a mean of 48.4% correct responses to test questions. The post-test was completed by 117 participants (87.3%) with a mean of 74.2% correct responses, representing a statistically

significant improvement in test scores ($p < 0.0001$). Class-average normalized educational gain was 50%.

The course evaluation form was modified between the third and fourth sessions of the course; however, 14 questions remained common during the 2 time periods. The results of the course evaluations completed by 128 participants (95.5%) are summarized in Table 2. The course was scored highly in the 14 areas of the evaluation with average responses ranging from 4.44 to 4.86.

TABLE 2
Responses to the Course Evaluation

	Score (mean±SD)[a]
Effectiveness of lecture topics	
Medical and economic issues of renal replacement therapy	4.50±0.632
How peritoneal dialysis works	4.67±0.538
Preoperative patient assessment and preparation	4.44±0.726
Catheter implantation	4.86±0.371
Salvage procedures for infectious and mechanical complications	4.72±0.522
Effectiveness of surgical laboratory stations	
Preoperative mapping	4.75±0.472
Laparoscopic rectus sheath tunneling	4.71±0.542
Laparoscopic omentopexy	4.70±0.495
Implantation of extended catheters	4.68±0.551
Catheter tunneling, embedding, and dressings	4.62±0.582
Overall course rating	
Meeting organization	4.79±0.480
Course agenda	4.74±0.439
Group size	4.71±0.472
Allotted time for hands-on laboratory exercises	4.69±0.514

[a] Responses to effectiveness of lecture topics and laboratory stations and overall course ratings were scored on a 5-point Likert scale with 1 = very low and 5 = very high.

Fifty-nine (44%) of the course participants responded to the online follow-up survey conducted a mean of 27.5 ± 13.8 months (interval: 5.6 – 49.2) after the PDUS programs. There was significantly increased utilization of all 10 course-targeted PD access skills (Table 3). After attending the PDUS, the participants felt more confident in their ability to place catheters and manage complications, their catheter outcomes were improved, and the volume of catheter placement procedures increased (Table 4).

DISCUSSION

A comprehensive 1-day training course in peritoneal access surgery fills a current educational deficit in surgical residency training and at the same time offers an effective learning program that minimizes the surgeon's time away from a busy practice. Peritoneal Dialysis University for Surgeons takes a disease-based approach to this educational experience by delivering in-depth knowledge about renal replacement therapy and provides a firm grasp of the cognitive elements related to PD access procedures. The course also recognizes the importance of providing the surgeon a hands-on opportunity to acquire new skills through the use of simulator-based training. The simulators permit guided learning, during which the participant acquires the skill to perform each step of the operative procedure under close supervision of an instructor.

Several metrics were used to gauge the success of the PDUS program, including pre- and post-tests, a course evaluation, and a follow-up survey. Pre- and post-tests were used to measure learning gain. While mean absolute learning gain (% post-test score – % pre-test score) was 25.8% and mean relative gain (% absolute gain / % pre-test score × 100) was 53.3%, we elected to use class-average normalized gain in order to diminish the confounding effects of pre-course knowledge and other potential baseline group characteristics. The normalized gain of 50% calculated for the PDUS program is well above the 30% threshold that is generally considered

TABLE 3
Follow-Up Survey of Peritoneal Dialysis Access Procedure Utilization[a]

Peritoneal access procedure	Using procedure before the course, *n* (%)	Using procedure after the course, *n* (%)	*p* value
Laparoscopic catheter implantation	41 (69.5)	50 (84.8)	0.0077
Rectus sheath tunneling	25 (42.4)	49 (83.1)	<0.0001
Omentopexy	22 (37.3)	49 (83.1)	<0.0001
Adhesiolysis	40 (67.8)	50 (84.8)	0.0044
2-piece extended catheter to upper abdominal	10 (17)	31 (52.5)	<0.0001
2-piece extended catheter to upper chest	5 (8.5)	23 (39)	<0.0001
Embedded catheter	16 (27.1)	31 (52.5)	0.0003
Catheter salvage by splicing	11 (18.6)	29 (49.2)	<0.0001
Simultaneous catheter replacement	13 (22)	29 (49.2)	0.0002
Preoperative mapping for selection of catheter type and exit site	13 (22)	42 (71.2)	< 0.0001

[a] Survey responses of 59 Peritoneal Dialysis University for Surgeons participants.

TABLE 4
Participant Responses to Follow-Up Survey Statements[a]

Statement	Score (mean±SD)
After attending PDU for Surgeons, I am more confident in placing catheters and managing complications. (1=strongly disagree, 2=disagree, 3=neutral, 4=agree, 5=strongly agree)	4.58±0.563
As a result of attending PDU for Surgeons, my catheter outcomes have: (1=greatly worsened, 2=worsened somewhat, 3=remained unchanged, 4=improved somewhat, 5=greatly improved)	4.39±0.588
Since attending PDU for Surgeons, the number of catheters I place each month has: (1=greatly decreased, 2=decreased somewhat, 3=remained unchanged, 4=increased somewhat, 5=greatly increased)	3.93±0.926

PDU = Peritoneal Dialysis University.
[a] Survey responses of 59 PDU for Surgeons participants.

the minimum value at which educational interventions can be regarded as effective (10–12).

Course and follow-up survey evaluations using Likert scale analyses were employed to study the curricular effectiveness and perceived values of the PDUS educational experience. Participants uniformly gave high scores on all queried elements. The follow-up survey also indicated that there was a significant increase in utilization of surgical skills taught in the course. One of the limitations of evaluating the efficacy of the PDUS program is not being able to monitor clinical outcomes after surgeons start performing these acquired skills; however, there is strong research evidence that simulator-based training, when included as part of a structured program, results in effective skills transfer to the patient-based setting (13). Most medical educators would agree that knowledge and skill acquisition eventually leads to improved patient care (14).

The follow-up response rate of surveyed PDUS participants was 44%, not dissimilar to the 32 to 48% response rates of other physician surveys using comparable online or postal methodology (7,15–17). Low physician response rates have been attributed to survey fatigue, survey loss, time demands, and general indifference. Low response rates potentially introduce nonresponse bias. Therefore, the views of the fewer responders may not represent the views of the larger population being surveyed. However, nonresponse bias may be of less concern in physician surveys than in surveys of the general public (17).

The results of the first 7 PDUS programs is an encouraging start towards shaping a surgical workforce into capable PD access providers. With minimal modifications based upon specific geographic regional needs and/or resource limitations, the course structure can be adapted to create similar programs on an international level. An important spinoff of the PDUS has been the development of an interventionalist program for radiologists and nephrologists entitled Peritoneal Dialysis University for Interventionalists (PDUI). Scheduled in tandem with the PDUS courses, 2 PDUI programs have been conducted to date with the same favorable responses from the attendees. A common course objective now exists for both programs, namely, surgeons and interventionalists working collaboratively to develop common pathways and techniques to provide timely peritoneal access and to resolve PD complications. Dates and locations of future programs can be found under Events & Meetings on the ISPD website (www.ispd.org) or the individual websites for the PDUS (www.pdusurgeons.com) and PDUI (www.pduinir.com) programs.

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DISCLOSURES

JHC has served as a consultant for MedComp, Inc. and Baxter Healthcare and as a speaker for Baxter Home Therapies Institute, DaVita Healthcare Partners, and Fresenius Medical Care. TP is a Baxter Healthcare consultant and a speaker for DaVita Healthcare Partners and Fresenius Medical Care. SWA is a consultant and speaker for Baxter Healthcare. JB serves as a consultant, medical advisory board, for NxStage Medical.

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