

## ORIGINAL ARTICLE

## Referred Shoulder Pain in Patients Undergoing Peritoneal Dialysis

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## ABSTRACT

Peritoneal dialysis is a popular mode of renal replacement therapy worldwide. Infusion of peritoneal dialysate fluid in the peritoneal cavity may be associated with pain. We prospectively evaluated the occurrence of the infusion of pain in incident patients on peritoneal dialysis. The clinical course and factors associated with this manifestation are presented. Four out of 87 end-stage renal disease patients (5%) who started peritoneal dialysis in our center developed shoulder pain. Beginning immediately after the initiation of dialysate infusion, the shoulder pain was more severe on the left side, and radiated to the chest, then went posterolaterally down the upper extremities, up the lateral side of the hand and digits. No severe underlying clinical problem or catheter malposition was discovered. The referred pain gradually relieved by 3 weeks to 4 months. In conclusion, radiating shoulder, chest, and upper limb pains are transient and seemingly benign complications of peritoneal dialysis. *Biomed. Int. 2010; 1: 34-36. ©2010 Biomedicine International, Inc.*

**Key words:** pain, peritoneum, peritoneal dialysis, shoulder

## INTRODUCTION

Peritoneal dialysis is a popular mode of renal replacement therapy worldwide. The peritoneal cavity is the space between the parietal and visceral peritoneum, lining the abdominal wall and surface of the intraperitoneal structures.<sup>1</sup> During continuous ambulatory peritoneal dialysis, the peritoneal cavity is filled with approximately 2 L of dialysate solution per treatment.<sup>1</sup> This amount of fluid could potentially fill the various peritoneal recesses.<sup>2,3</sup> Standard peritoneal dialysate fluid has an acid pH, a high osmolality, a high lactate concentration, a high glucose solution, and contains toxic glucose degradation products. All of these components have been reported to cause cellular toxicity. Glucose degradation products generally have been held responsible for infusion-related abdominal pain.

Bacterial peritonitis is the major complication of peritoneal dialysis followed by catheter-related morbidities such as leakage, obstruction, and catheter malposition.<sup>5,6</sup> Maaz postulated that shoulder pain in peri-

toneal dialysis patients may be related to pneumoperitoneum, malpositioned peritoneal dialysis catheter, or bowel perforation.<sup>7</sup> In the present study, all incident patients on peritoneal dialysis were prospectively followed for the occurrence of pain on dialysate infusion. The potential causes of this pain are discussed.

## PATIENTS AND METHODS

From November 2003 to March 2006, 87 end-stage renal disease patients received peritoneal dialysis (male:female ratio, 40:47; aged 2-79 y) in our institution. Briefly, peritoneal catheters were inserted either by open surgery, laparoscopy, or bedside techniques, and dialysis was started at least 10 days thereafter. The first sessions were performed with low dialysate volumes (1 L of 1.5% glucose solution per session 4 times daily) in the supine position followed by 2 L of dialysate after 1 week. We followed all of our peritoneal dialysis patients for shoulder, chest, and upper limb pains following dialysate infusion.

## RESULTS

A total of 4 patients (5%) were found to have bilateral shoulder and upper limb pain and paresthesia initiated by peritoneal dialysis. Pain also was described over the inferior thorax bilaterally. Physical examination of these patients revealed normal shoulder and upper limb joints. All patients were female with an age range of

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Submitted May 20, 2009; accepted in revised form July 19, 2009.

Advance Access Publication 15 December 2010 (see [www.bmijournal.org](http://www.bmijournal.org))

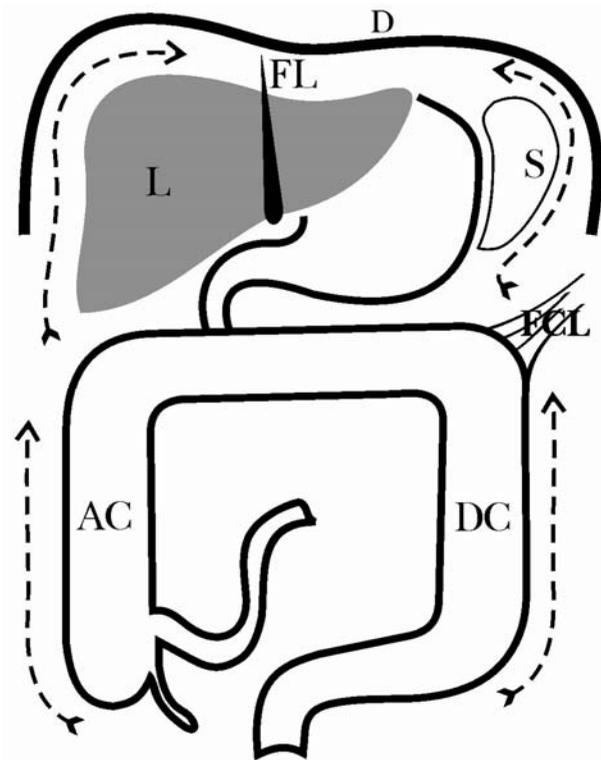
24-40 years. The known causes of renal failure were chronic renal allograft rejection, chronic glomerulonephritis, and scleroderma. One of the patients had a history of abdominal surgery (renal transplant 13 years earlier). The pain was more severe on the left side and radiated posterolaterally down the upper extremities, up to the lateral side of the hand and digits. The pain was initiated immediately after dialysate inflow, and worsened in the supine position or with deep inspiration, and was relieved by sitting or standing. No relation was found between catheter tip position and pain symptoms. Past history was unremarkable for similar episodes of shoulder pains. Chest radiographs and electrocardiography of the patients were unremarkable. No free air was detected under the diaphragm. Plain abdominal radiographs revealed that the peritoneal dialysis catheters were in an appropriate position within the pelvis. Peritoneal fluid examination was negative for any infection or sign of inflammation. No obvious shoulder pathology or limitation in joint motion was found on physical examination.

Patients with referred shoulder pain was placed on a lower volume of dialysate (1-1.5 L per session). The patients also were advised to keep the peritoneal space dry during the night when they were primarily supine. The pain was transient and gradually relieved by 3 weeks ( $n = 3$ ) to 4 months ( $n = 1$ ). Then, the dialysate was increased to ~2 liters per day. The 4-month pain symptom was seen in the 1 patient with scleroderma who is still on a lower infusion volume (1.5 liters of dialysate).

## DISCUSSION

In the present study, we found that 5% of incident peritoneal dialysis patients developed infusion-related pain. Since peritonitis, catheter malposition, and other complications were excluded, the pain syndrome could be attributed to referred pain. The transient and self-resolving course of this pain may be due to a sensory adaptation mechanism. The bilateral shoulder/upper limb pains may be due to subdiaphragmatic irritation with dialysate fluid.<sup>8</sup> The parietal peritoneum on the inferior surface of the diaphragm is supplied by the phrenic nerve, and by the lower intercostal nerves.<sup>9</sup> The phrenic nerve (C3, C4, and C5) is the motor nerve of the diaphragm and also contains many sensory and sympathetic fibers. Dialysate fluid-induced irritation of the diaphragmatic peritoneum may result in a referred pain in the distribution of the C5 nerve root along the musculocutaneous, axillary, radial, and median nerves. Referred right shoulder pain from the irritation of diaphragmatic peritoneum also has been reported in pediatric patients with ventriculoperitoneal shunts.<sup>10</sup>

The left subphrenic space lies between the diaphragm and the anterosuperior surface of the left lobe of the liver and superior surface of the stomach and spleen. Contralaterally, the right subphrenic space is located between the diaphragm and the anterosuperolateral surface of the right lobe of the liver. This space is



**Fig. 1.** Schematic demonstrating the dialysate flow within the peritoneum. D, diaphragm; L, liver; S, spleen; AC, ascending colon; DC, descending colon; FL, falciform ligament; FCL, phrenicocolic ligament.

bounded on the left side by the falciform ligament and posteriorly by the coronary ligament.<sup>9</sup> The right subphrenic space is easily assessable for intraperitoneal fluid via the right paracolic gutter. The left subphrenic space is usually larger than the right side.<sup>9,11</sup> Moreover, the phrenicocolic ligament extending from the underside of the diaphragm to the splenic flexure of the colon produces a partial barrier for lower abdominal fluid to reach the left subphrenic space via the left paracolic gutter.<sup>2,9,11</sup> Intraperitoneal fluid is directed by gravity to dependent sites within the peritoneal cavity. In the supine position, cephalic movement of dialysate fluid could reach the right and left subdiaphragmatic spaces (Fig. 1). Deep inspiration would enhance symptomatology of diaphragmatic irritation.<sup>2,9</sup> Interestingly, Mahmud and associates, in a deceased-donor study, demonstrated that 500-1000 mL of fluid is sufficient to distribute to all peritoneal compartments.<sup>2</sup> In their study, cadavers with a larger phrenicocolic ligament, required a greater volume of fluid for adequate distribution to the left subphrenic space.

The clinician should consider shoulder, chest, and upper limb pain as a transient and seemingly benign complication of peritoneal dialysis.

## ACKNOWLEDGMENT

We would like to thank Professor Dr. Said Rad, from Tabriz University of Medical Science for his comments.

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