Peritoneal Dialysis as a Safe and Effective Renal Replacement Therapy for Patients with Major Vascular Catastrophies

Rajeevalochana Parthasarathy\textsuperscript{1}, Usman Khalid\textsuperscript{2}, Susan Philip\textsuperscript{3}, Milly Mathew\textsuperscript{4}, Rudreshwar P\textsuperscript{1}, Athulya Mary Joy\textsuperscript{1}

\textsuperscript{1}Madras Medical Mission, Chennai
\textsuperscript{2}Pakistan Institute of Medical Sciences, Islamamad, Pakistan
\textsuperscript{3}Pondicherry Institute of Medical Sciences, Pondicherry, India

\textit{ABSTRACT}: AKI in the setting of major vascular catastrophies are a challenge in view of its multifactorial nature and hemodynamic instability. PD is an option of Renal replacement therapy which can be used successfully in such settings with minimal complications and in a cost effective manner. We hereby present two case scenarios of Aortic aneurysmal rupture and dissection with AKI which were managed with peritoneal dialysis with a review of literature.

\textbf{Keywords}: Aortic dissection, peritoneal dialysis

\section*{Introduction}

Aortic aneurysmal rupture (AAR) and Aortic dissection (AD) are major catastrophic vascular events. They can either complicate the scenario in a patient with preexisting end stage renal disease or cause acute kidney injury (AKI) needing renal replacement therapy. Peritoneal dialysis (PD) may offer considerable advantages including better hemodynamic stability and avoidance of anticoagulation in these critically ill patients. Institution of PD in such patients, however, often gives rise to concerns relating to peritonitis and subsequent infection of the prosthesis, fluid leaks, wound dehiscence and abdominal failure requiring dialysis. Review of available literature suggests that PD can and has been utilized in both acute and chronic renal failure settings following intraabdominal vascular procedures and aortic dissections. It appears to be an efficient mode of dialysis with minimal complications. (1) We present two case scenarios with Aortic dissection in both Acute and Chronic Kidney failure settings where we used PD as renal replacement therapy successfully.

\section*{Case 1}

A 42 year old gentleman a hypertensive on beta blockers was referred to our center with aortic dissection and oliguric renal failure. Patient was asymptomatic till a week prior to admission when he developed sudden onset of pain over the neck and jaw radiating to the arm and back followed by blurring of vision. He also had numbness of right upper limb. He was taken to a local hospital where he was started on ionotropes and Intravenous fluids as he was hypotensive. Three days later patient developed sudden onset of pain at the back radiating to gluteal region and both thighs and oliguria and was diagnosed with AKI. He was already initiated on haemodialysis when he came to us. He was oliguric at presentation and was hypertensive with a BP of 150/110 at presentation. He was continued on hemodialysis initially...
here. ECHO showed dilated aortic root, sinus and sinotubular junction. All cardiac chambers were normal sized with good Left ventricular systolic function. Ascending aortic dissection flap was seen and there was mild aortic regurgitation. CT aortic angiogram was done which showed aortic dissection involving ascending, arch, descending thoracic and abdominal aorta, bilateral common carotid, subclavian, hepatic, superior mesenteric artery, left renal, bilateral common, external iliac artery and left internal iliac artery. True lumen was collapsed at right common carotid artery, distal thoracic and abdominal aorta and at the level of origin of bilateral renal arteries. Right subclavian artery originated from false lumen with severe stenosis. Bilateral renal arteries originates from collapsed true lumen. Fifty percentage stenosis noted in the hepatic artery (Figure 1A)

Patient underwent Ascending aortic replacement and preservation of the native valve. (2) A Swan necked Tenckhoff PD catheter was placed by open surgical technique intraoperatively. Supine low volume peritoneal dialysis was started and his renal parameters gradually improved. He recovered from the AKI completely at discharge. One month later a DTPA scan was performed which showed good uptake and adequate GFR in both the kidneys and the PD catheter was removed.

Case 2

A 61 years old male with diabetic nephropathy with End stage renal failure on Continuous ambulatory peritoneal dialysis (CAPD) for 10 months, on 4 exchanges per day with a good ultrafiltration with no residual renal function presented with upper back ache with no radiation or associated dyspnea. He did not have any aggravating or relieving factors. On examination his blood pressure was 160/90mm Hg, Cardiac examination revealed a regular good volume pulse with a short end diastolic murmur in the aortic area on auscultation. Rest of the systemic examination was unremarkable. We did an Transthoracic Echocardiogram which revealed an aortic aneurysm involving ascending aorta with dissection flap noted in the proximal ascending aorta extending upto arch of aorta mild AR and moderate systolic dysfunction. A CT Coronary angiogram and CT Aortic angiogram were done which showed calcified plaque in LMCA LAD LCX and RCA without significant stenosis. Aortic dissection was seen with intimal flap seen extending from aortic root swirling along the ascending aorta and just ending proximal to origin of left subclavian artery. The false lumen was larger in caliber and laying on right side and true lumen was smaller in size and laying on left side There was no extension of flap seen into arch vessels (Figure 1B). Patient underwent Aortic root replacement with hemiarch replacement (Modified Bentalls Procedure)(3). Prior to the surgery CAPD exchanges were increased from four to five per day for better volume and hemodynamic control. On day of surgery before shifting to the operation theater two exchanges were done and he underwent the surgery without any volume or electrolyte derangements. He was put back on his previous CAPD regimen at discharge.

Fig. 1 : 3D reconstructed CT Aortic angiogram images showing extensive aortic dissection (Figure 1A) and dissection involving the ascending aorta (Figure 1B)
Discussion

Acute aortic dissection is a life threatening condition which requires early diagnosis and treatment. Aortic dissection occurs when tear of intima in the aorta leads to the leak of high blood pressure into the media causing further separation of the two layers further downstream. As a result, the true lumen may be compressed or blocked by the surrounding false lumen, which may cause complications such as renal failure, intestinal ischemia or necrosis, internal bleeding or even death. The incidence of AKI following AAR is anywhere between 17% to 26% (5,6) and is associated with a high mortality rate of up to 87% (7).

Aortic dissection is acute if the diagnosis is made within two weeks following the onset of symptoms and chronic if present for more than two weeks. Aortic dissection is classified according to De Bakey/ Stanford classification. Most commonly used is the Stanford classification, based on the involvement of the ascending aorta. Type A involves the ascending aorta, but may extend into the arch and descending aorta (De Bakey I and II). Type B involves the descending aorta only (De Bakey III)(8).

Systemic hypertension is the most common risk factor for aortic dissection as in both our case scenarios. Other causes include atherosclerosis, marfan syndrome, takayasu arteritis, trauma, cardiac catheterization and pregnancy(9).

Acute renal failure is a rare complication of aortic dissection. Urgent dialysis is often required in these patients to decrease the mortality but haemodialysis is not advisable in critically ill patients because of the haemodynamic instability and the risk of bleeding from anticoagulation therapy. Slower therapies like Continuous renal replacement therapies need experienced personnel and is expensive and may not be feasible in all centers in a developing country like India. In such cases peritoneal dialysis is useful as it doesn’t require anticoagulation and provides better haemodynamic stability.

The Peritoneal membrane has a surface 1 to 2 m2. Visceral peritoneum constitutes 80% of overall peritoneal membrane and gets its vascular supply from mesenteric arteries and portal vein, remaining 20% is formed by parietal peritoneum which gets its vascular supply via arteries and veins of the abdominal wall. Peritoneal dialysis is mainly mediated by the parietal peritoneum. The Peritoneal blood flow is thought to be about 50-100 ml/min. Peritoneal cavity is lined by a single layer of mesothelial cells which produces a thin layer of peritoneal fluid. Under the mesothelium is a gel like interstitium containing connective tissues, capillaries and lymphatics. (10) The effective peritoneal surface area is critical for dialysis and depends on the vascularity of the peritoneum as well as its surface area. Figure 2A and 2B shows the anatomy of the peritoneal membrane. In the first case illustrated, although there was extensive aortic dissection and compromise of vascularity to the peritoneal dialysis, the ultrafiltration or the dialysis was not hampered.

A retrospective study by Hajarizadeh et al, reported an interesting observation on the use of peritoneal dialysis following ruptured abdominal aortic aneurysms. PD catheters were placed prophylactically in 69 of 105 patients who
underwent grafting for ruptured abdominal aortic aneurysm. Criteria for placement included shock, perioperative oliguria and pre operative renal insufficiency. Acute tubular necrosis developed in 31 patients, 19 of whom required dialysis. Peritoneal dialysis alone (8 patients) or in combination with haemofiltration and/or haemodialysis (9 patients) provided effective dialysis for these patients with an overall efficacy of 58%. The authors concluded that PD in such patients is without significant complication and can facilitate early and efficient dialysis (11).

We did not rush into surgery even though the patient was in oliguric renal failure. He underwent an emergent dialysis to control the fluid overload and high serum potassium. The choice of dialysis was peritoneal dialysis post operatively due to the simplicity and the nature of urgency. This was critical for the fast recovery post operatively in this case.

The patient with renal failure is more susceptible to infection due to an altered immune state. Peritonitis is one of the common complications of PD, and the theoretical risk of subsequent graft infection always remains. Though the risk of bacteremia in patients on chronic PD is unknown, it is probably very small (12). In the hands of a skilled nurse and a meticulous procedure, PD in these patients should be a mode to be followed.

Conclusion

This case report highlights that PD is a safe and efficient modality even in patients with severe aortic dissection complicated by AKI and in ESRD patients. Vascular catastrophes’ present with challenging hemodynamics and multiorgan involvement Managing AKI or ESRD in these situations should take into account the patient profile and we have to ensure that patient remains hemodynamically stable. PD may be a safe, effective and cost effective way of providing renal replacement in these patients.

References


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