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CASE REPORT

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A Case Report of A Drop Foot Developed After Common Femoral Artery Cannulation for Venoarterial Extracorporeal Membrane Oxygenation

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ABSTRACT

The drop foot cases that are associated with developing neuropathies as a result of acute compartment syndrome or femoral artery ischemia after having cannulation for venoarterial extracorporeal membrane oxygenation (VA-ECMO) have been reported rarely in literature. In this case report, female patients who are 21 years old and developed drop foot depending on ECMO during the process of lung transplantation will be presented as both to be one of the rare neurological complications connected to ECMO and its possible causes will be analyzed.

Keywords: Acute compartment syndrome, drop foot, extracorporeal membrane oxygenation, lower extremity ischemia

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INTRODUCTION

Extracorporeal membrane oxygenation (ECMO) is an effective method on the view of a bridge by the recovery of postoperative outcomes of lung transplantation and it was highlighted as an evident in the studies that have been conducted recently (1). On the other hand, complications can be developed with ECMO such as primary mechanical, vascular, renal, lung and neurological. Acute compartment syndrome is a rare complication of ECMO implementation that could be occured as a consequence of developing ischemia or reperfusion impairment of the extremity during application (2). This syndrome is a emergency surgery indication. It may occur in all extremities and body space. It is frequently observed especially with the lower extremities as a result of trauma and less frequently after exposing prolonged compression and vascular injury. The clinical manifestation develops within hours in conclusion of ischemia and necrosis caused by increase of pressure in all tissues within compartment (3).

CASE

Twenty-one-year-old female patient (weight: 38 kg, hight: 148 cm, BMI: 17.34) without any neurological and vascular disease who developed severe pain and peripheral edema in the right lower extremity on the first postoperative day following the femoral artery cannulation for venoarterial ECMO performed during the lung transplantation process. Then, the added to the symptoms above cyanosis, ischemia and loss of heat in extremity were observed. It was detected that motor weakness and sensory loss in the right lower limb in the neurological examination by a neurologist on the second postoperative day. Motor loss of strength was as follows; hip flexor 4/5, knee extensor 4/5, ankle dorsiflexor 0/5, great toe extensor 0/5 and ankle plantar flexor 1/5 in the affected limb by Manuel muscle test (Medical Research Council, MRC). In addition, the patient's pulse lost on the popliteal artery and the posterior tibial artery in affected extremity. It suggests that this clinical condition may be acute compartment syndrome; therefore, patient's superficial ultrasound (sUSG) and arterial-venous Doppler ultrasound (dUSG) was performed and forms of patient constent was taken during the hospitalization for all the considerations have been made. Venous structures are within normal limits yet revealed a monophasic flow in the right anterior tibial artery in affected extremity and diameter of common femoral artery was detected 6.3 milimeter by dUSG. Also interstitial edema was found in skin and under the skin soft tissue by sUSG. Lesions detected by magnetic resonance imaging (MRI) showed signal changes in heterogeneous character which they were hypointense on the T1-weighted sequences and hyperintense on T2-weighted sequences, also had intense contrast enhancement, where starting from the middle part of the tibial level in the area extending from proximal to distal medullary and muscles that are located adjacent to this area as tibialis

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anterior (TA), extensor hallucis longus (EHL), extensor digitorum longus (EDL), peroneus longus (PL), and as more less tibialis posterior (TP), gastrocnemius (GC) in MRI (Figure 1).

We thought that the development of the neurovascular complications after cannulation of the femoral artery and vein due to exceed compartment presure in patient's undergoing ECMO. Then, treatment was initiated after consultations of cardiovascular surgery, physical therapy and rehabilitation in intensive care unit which treatment was nonsteroidal anti-inflammatory treatment, 900 mg/day gabapentin for pain control therapy, further elevation of the extremity and other physical therapy.

Electromyograpic (EMG) examination was performed on the 10th day of developing droop foot in right lower extremity. The results were detected as the right peroneal nerve motor response by recording of the muscle of TA and EDB with the right sural and the right superficial peroneal sensory responses could not be obtained, moreover right tibial nerve compound muscle action potential amplitude was slightly lower in nerve conduction study. In addition, motor unite potentials of EDB, TA and EHL muscles could not be exited during voluntary muscle contraction whereas intense positive spines and fibrillation potentials on theese muscles during rest showed by needle electromyograph. As a result, according to the findings of this EMG, it was decided that acute axonal degeneration as markedly common peroneal nerve and lesser extent tibial nerve in the right distal extremity (Table 1).

Pain and swelling reduce right lower extremities of patient with treatment during clinical follow-up. It was detected a rate of 2/5 dorsal flexion weakness in the right big toe and hypoesthesia on peroneal area of the right foot in the patient's control after treatment in the second months. On the other hand, it was detected that continued intense denervation activity according to the first study on the 10th day and began especially partially reinervation TA muscle in the second month on the patient's control the EMG's.

DISCUSSION

Extracorporeal membrane oxygenation is generally used in patients that indicated for the management of life-threatening pulmonary or cardiac failure when no other form of treatment has been or is likely to be successful to improve oxygenation (4). The system consists of two vascular cannulas. Venous canul enables the removal circulation outside the body through an artificial lung with a pump. It provided oxygenation of deoxygenated blood in the venous system. Afterwards, oxygenated blood is returned to the circulation using the arterial cannula that it can be venous system either through venovenous method (VV) or the arterial system through venoarterial method (VA) that is generally used in the femoral artery or vein for catheterization (4). The latter representing Femoral VA-ECMO cannulation that is known to provide effective cardiopulmonary support for cardiac and pulmonary patients is preferred on the preoperative or postoperative periyod of lung transplantation (1).

Unfortunately, VA-ECMO produces a relatively high risk of complications that include primary mechanical, renal, lung and neurological. The most important factors that could cause complications is underlies etiologies. Neurological complication have been shown more than 30% of patients treated with ECMO in adult (5). Also this ratio was reported as 22% in children (6). Distal limb ischemia is a well documented complication when the femoral VA-ECMO cannulation, and this ratio was reported as 18–30% in adults (7). There are multiple reports describes placement of a small diameter catheter distally to provide antegrade flow to the ischemic limb at the time of initial open ECMO cannulation in adults (8). Also, the distal limb ischemia after applied to femoral VA-ECMO was reported more frequently mainly in children due to artery diameter (9).

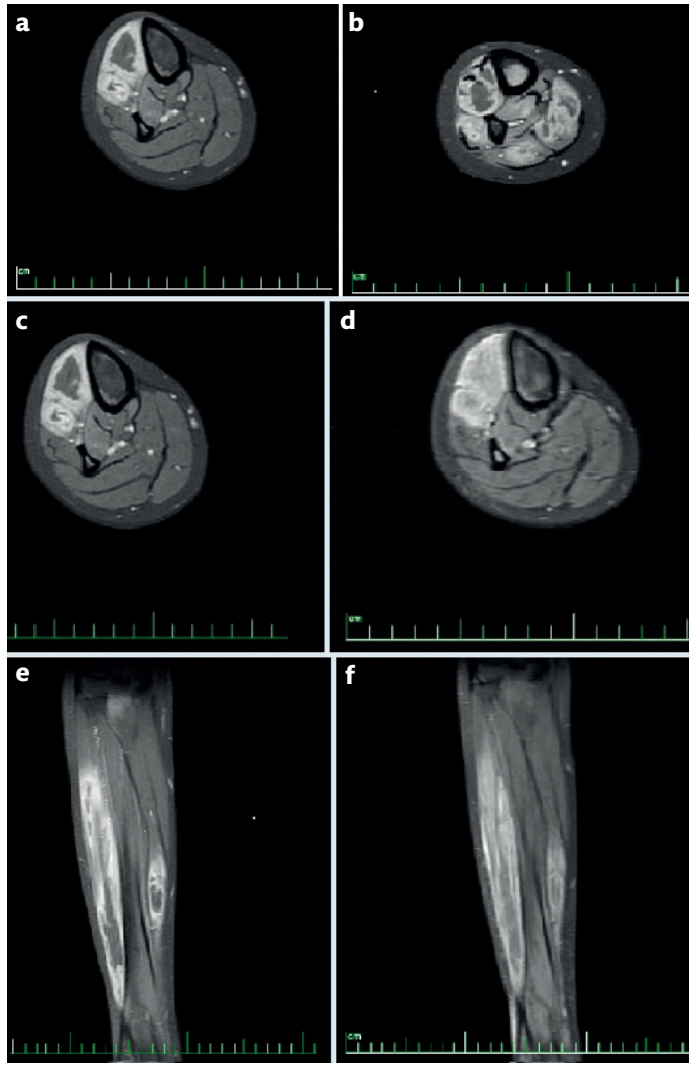

Figure 1. (a and c: T1 axial + contrast, b: T2 axial, d: Axial PD fat, e: T1 sagital+contrast, f: Sagital PD fat)

As it is known, acute compartment syndrome can develop as a result of limb ischemia or reperfusion during ECMO (2). The anterior compartment is an enclosed space arround rigid walls. When the anterior compartment pressure exceeds the intra-arterial pressure that this will produce venous stasis and also arterial occlusion, it results in muscles swelling and eventually necrosis of muscle and nerves duo to prolonged limb ischaemia. The nerve damage may vary depending on the duration of ischemia and degree of occlusion (10). In this case that developed drop foot in the postoperative period, it was observed necrosis of developed secondary to ischemia, impairment of arterial flow and venous stasis in dUSG in accordance with the EMG and clinical examination. We thought that might be effect small diameter of the femoral artery in the etiology as previously stated in the pediatric literature. In addition to applied longer VA-ECMO during lung transplantation process on the both preoperative and postoperative period can be effective on another important factor for prolonged distal arterial ischemia.

Consequently, acute axonal degeneration of the common peroneal nerve can be improved secondary to distal ischemia as results of increased pressure inside the compartment with stasis and edema occurring during the application VA-ECMO. This is not a rare case particularly in adult individuals with small diameter arteries. it should be noted that the possible neurological complications that may arise during the application VA-ECMO.

Table 1. Electromyographic findings

NCS		Lat [m/s]		Amp [µV]		Velocitiy [m/s]	
		R	L	R	L	R	L
SENSORY	**Sural (Lat Mall Antidr)**						
	10th day	NR	3.90	NR	13.7	NR	50.8
	1th month	NR	3.85	NR	12.1	NR	51.2
	2nd month	NR	2.15	NR	15.1	NR	46.5
	Sup peroneal (Ankle Antidr)						
	10th day	NR	1.95	NR	11.4	NR	51.8
	1th month	NR	2.01	NR	10.8	NR	52.2
	2nd month	NR	2.10	NR	11.5	NR	47.6
MOTOR R RR	**Comm peroneal (EDB)**						
	10th day	NR	3.15/10.15/12.25	NR	4.5/4.5/4.3	NR	47.6/42.6
	1th month	NR	3.05/11.10/11.05	NR	4.8/4.6/4.5	NR	45.8/44.4
	2nd month	NR	3.15/9.15/11.6	NR	4.4/4.4/4.3	NR	46.7/44.9
	Comm peroneal (Tib Ant)						
	10th day	1.95/4.40	-	0.2/0.3	-	42.8	-
	1th month	2.50/4.40	-	0.4/0.1	-	41.3	-
	2nd month	2.15/3.95	-	1.1/1.1	-	55.6	-
	Tibial (knee) (AH)						
	10th day	4.10/14.35	4.85/14.10	3.8/3.2	7.1/6.5	41.0	42.2
	1th month	4.05/13.0	4.55/12.35	5.0/3.8	7.0/5.9	40.8	41.6
	2nd month	4.65/14.45	4.20/12.75	6.2/4.9	8.7/8.8	47.4	46.6

EMG SUMMARY TABLE

R	Spontaneous			MUAP			Recruitment
	Fib	PSW	Fasc	Amp	Dur.	PPP	Pattern
Quadriceps							
10th day	None	None	None	N	N	N	N
1th month	None	None	None	N	N	N	N
2nd month	None	None	None	N	N	N	N
Vast lateralis							
10th day	None	None	None	N	N	N	N
1th month	None	None	None	N	N	N	N
2nd month	None	None	None	N	N	N	N
Tib anterior							
10th day	4+	1+	None	NoA	NoA	NoA	NoA
1th month	3+	3+	None	1+	1+	1+	Discrete
2nd month	1+	1+	None	2+	3+	3+	Reduced
Peron longus							
10th day	1+	None	None	N	N	N	Reduced
1th month	1+	None	None	N	N	N/1+	Reduced
2nd month	1+	None	None	1+	1+	1+	Reduced
Gastrocn (med)							
10th day	1+	None	None	N	N	N	Reduced
1th month	1+	None	None	N	1+	1+	N
2nd month	N	None	None	N	1+	N	N
Ext dig brevis							
10th day	4+	4+	None	NoA	NoA	NoA	NoA
1th month	4+	4+	None	NoA	NoA	NoA	NoA
2nd month	4+	4+	None	NoA	NoA	NoA	NoA
Ext hall long							
10th day	4+	4+	None	NoA	NoA	NoA	NoA
1th month	4+	4+	None	NoA	NoA	NoA	NoA
2nd month	4+	4+	None	NoA	NoA	NoA	NoA
Tib Posterior							
10th day	1+	None	None	N	N	N	Reduced
1th month	1+	None	None	N	N/1+	N/1+	Reduced
2nd month	N	None	None	N	N/1+	N/1+	Reduced

NoA: No activity

Ethics Committee Approval: Ethics committee approval was received from the ethics committee of Yedikule Thorax Diseases and Surgery Training and Research Hospital.

Informed Consent: Written consent was obtained from the patient.

Peer-review: Externally peer-reviewed.

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