J Vet Clin 24(3) : 426-431 (2007)

Journal of Veterinary Clinics
www.ksvc.or.kr

Intrahepatic Portosystemic Shunt Fixed By Transvenous Coil Embolization in a Samoyed Dog

Moo-Hyun Lee, Seoungjin Lee*, Seung-Gon Lee, Hyeong-Sun Moon, Joon-Seok Lee, Ran Choi*, In-Chul Park and Changbaig Hyun[1]**

*Section of Small Animal Internal Medicine, *Lee Seoung jin Animal Hospital, Ulsan, Korea*
**Section of Diagnostic Imaging, School of Veterinary Medicine, Kangwon National University, Chuncheon, Korea*

(Accepted: September 7, 2007)

Abstract : A 5-month-old female Samoyed dog was presented with primary complaints including exercise tolerance and neurological sign associated with hepatic encephalopathy. The major findings in clinical examination included an intermittent seizure, anemia, elevated pre- and post-prandial serum bile acid, hypoproteinemia and bilirubinuria. Diagnostic imaging studies revealed an intrahepatic portosystemic shunt (IPSS). The shunted vessel was successfully occluded by transvenous coil embolization. Clinical signs were gradually improved after shunt occlusion. This case is a rare case of IPSS in a large breed dog fixed by transvenous coil embolization.

Key words **:** IPSS, Transvenous coil embolization, portosystemic shunt

Introduction

A portosystemic shunt (PSS) is an abnormal vascular connection between the portal vein and the caudal vena cava. The PSS can be classified as extrahepatic (shunts located outside the liver) or intrahepatic (shunts located inside the liver), single or multiple, and congenital or acquired. Either incomplete or botched closure of patent ductus venosus after birth is the main cause of PSS in dogs (4). To date, the exact mode of inheritance for this disorder has not been determined. Generally PSS is over-presented in certain dog breeds. The extrahepatic portosystemic shunts (EPSS) are more common in small breed dogs (e.g. Yorkshire Terriers, Miniature Schnauzers, and Maltese), while the intrahepatic portosystemic shunts (IPSS) are more common in large breed dogs (e.g. Irish wolfhound, Old English sheepdog, Golden and Labrador Retrievers, Samoyed) (2,8).

Most dogs with PSS will develop clinical signs early in life. The common clinical signs involve the nervous system, gastrointestinal tract, and urinary tract (4). Liver enzymes are often not significantly elevated in dogs with PSS. The more common biochemical changes in PSS include decrease in albumin, cholesterol, glucose, blood urea nitrogen (BUN). Decreased urine specific gravity and ammonium biurate crystalluria are characteristic findings in PSS. Increased serum bile acids (fasting and 2-hour postprandial) and ammonia are most diagnostic findings in PSS.

Single congenital portosystemic shunts must be differentiated from multiple acquired shunts secondary to portal hypertension, and from hepatic microvascular dysplasia (HMD). For definitive diagnosis, a visualization of shunting vessel is required using an exploratory laparotomy, contrast radiography (portography), computed tomography, ultrasound, or nuclear scintigraphy.

Medical management of PSS is directed to prevent hepatic encephalopathy (e.g. tylosin, neomycin, lactulose, dietary protein restriction) and to minimize hepatic cellular injuries (e.g. antioxidant, silymarin). Ultimately, all dogs with PSS are required either surgical or non-surgical occlusion of shunted vessel(s). Gradual ligation (for preventing portal hypertension) using gas sterilized strips of cellophane tape and ameroid constrictors is the most commonly used method for EPSS. Transvenous coil embolization (TCE) has been successfully applied to occlude the shunted vessel located inside the liver (1,7). Because overzealous occlusion of a shunt vessel can result in acute portal hypertension, which can cause ascites, bowel ischemia, and endotoxemic shock, animals have to be monitored closely (4). Prognosis of PSS is fair if the shunted vessels are occluded by either surgical or transvenous method.

In this case study, we described successful occlusion of IPSS in a large breed dog using TCE method.

Case

A 5-month-old female Samoyed (weighing 25 kg) was referred to the Veterinary Teaching Hospital, Kangwon National University with primary complaints of exercise tolerance, ascites and occasional seizures. Before the presentation, the dog was received treatment for alleviating ascites. In physi-

[1]Corresponding author.
E-mail : hyun5188@kangwon.ac.kr

cal examination, the dog was anorexic and lethargic. The 12 lead- surface ECG and digital ECG recordings revealed a QT prolongation (QTc = 301 ± 12 msec, reference: 150-250 msec, Fig 1). Complete blood count (CBC) revealed mild anemia. Serum biochemistry revealed decreased blood urea concentration and increased pre- and post-prandial serum bile acid levels (Table 1). However, blood coagulation profiles were normal (Table 1). Urinalysis revealed ammonium urate crystaluria and bilirubinuria.

Diagnostic imaging studies revealed a cranial gastric axis deviation indicating small size liver, decreased number of portal veins in the liver and generalized enhancement of the hepatic echogenicity (Fig 2). The portal vein was not tapered in the hepatic parenchyma (Fig 2). For the portography, the explorative laparotomy was performed after the midline incision. The protography clearly visualized a single straight shunted portal vein to the caudal vena cava and did not identify any shunted vessels located outside the liver (Fig. 3). The ultrasonography revealed the maximal diameter of the shunted vessel inside the liver. The ultrasonography also revealed the shunted vessel was 12 mm in diameter. Based on diagnostic findings, the case was diagnosed as IPSS.

With the consent from owner, we decided to occlude IPSS by lodging transvenous embolization coils. Although the diameter of shunted vessel was 12 mm, we decided to initially lodge an 8 mm (4 loops) coil (Flipper detachable embolization coils, COOK, Bloomington, USA), because the connection between portal vein and vena cava was concaved, and thus the smaller size coil would be more appropriate. Since the dog was hypoalbuminemic, plasma transfusion (15 ml/kg) with preventive antibiotics (cephazolin, 15 mg/kg) was performed before TCE. The dog were premedicated with

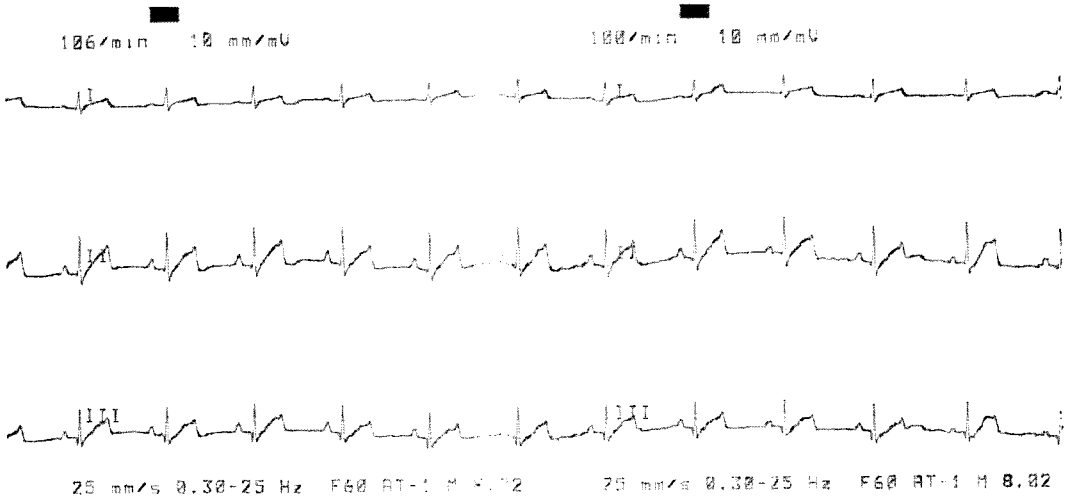

Fig 1. The electrocardiogram of this case. The electrocardiogram showed a abnormal QT prolongation (QTc = 301± 12 msec).

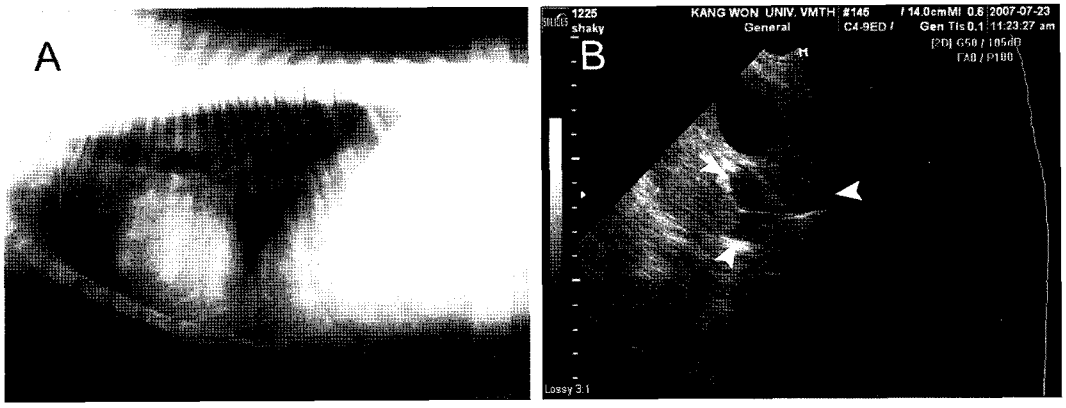

Fig 2. Abdominal radiography (A) and ultrasonography (B) of this case. Abdominal radiography revealed a cranial gastric axis deviation indicating small size liver and mild abdominal fluid accumulation. Ultrasonography revealed decreased number of portal veins in the liver and generalized enhancement of the hepatic echogenicity. The portal vein (arrow) was not tapered in the hepatic parenchyma.

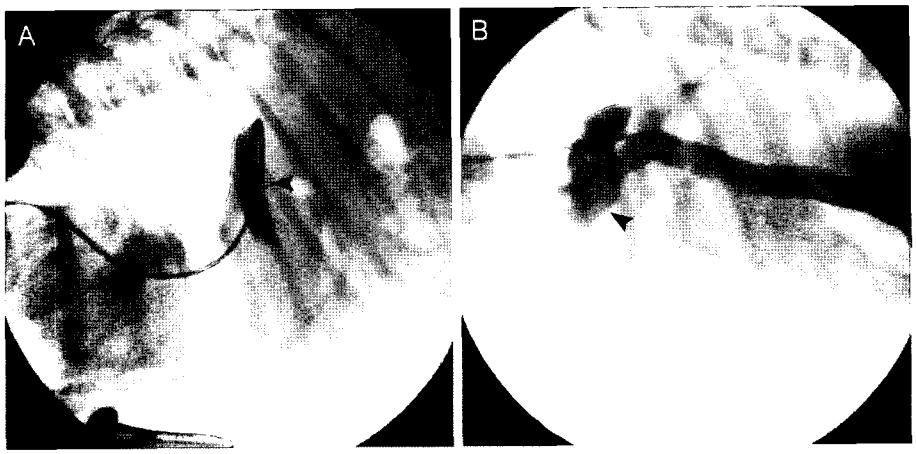

Fig 3. Angiography of this case. A: Venography. A contrast media was infused at the shunted vessel to visualize and to measure the size of shunt. The shunted vessel with ampulla (arrow) was clearly visualized in the left lateral hepatic lobe. B: Portography. A contrast media was infused from the mesentery vein to visualize the portal vasculature. There was a single straight shunt which drained into a venous ampulla (arrow) before draining into the caudal vena cava at the level of the diaphragm, suggesting the cause of portosystemic shunt was possibly persistent presence of patent ductus venosus.

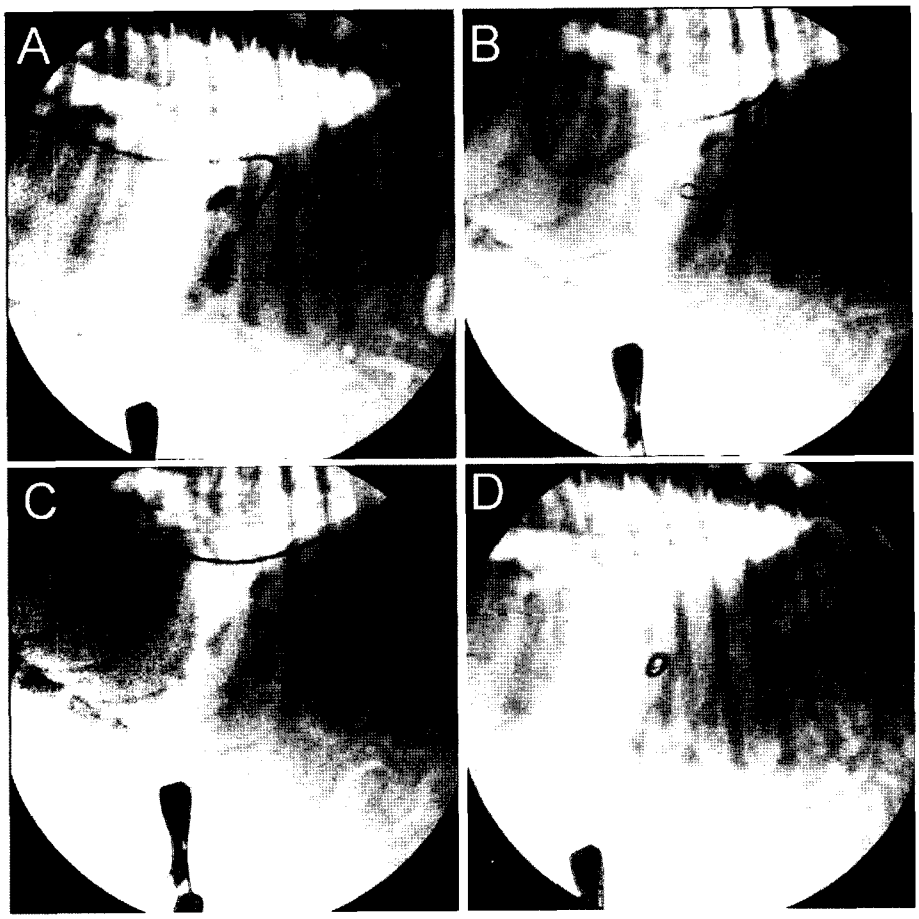

Fig 4. Transvenous coil embolization of this case. A : A 5F angiocatheter was inserted through jugular vein to visualize the shunted area. B : A guide-wire was then located at the shunt with the guidance of fluoroscopy. C : An 8 mm embolization coil (4 loops) was attached to a coil delivery system and then inserted into the angiocatheter. After locating at the shunt, the coil was released. D: After the release of coil, the pre-place catheter and introducer were removed from the jugular vein.

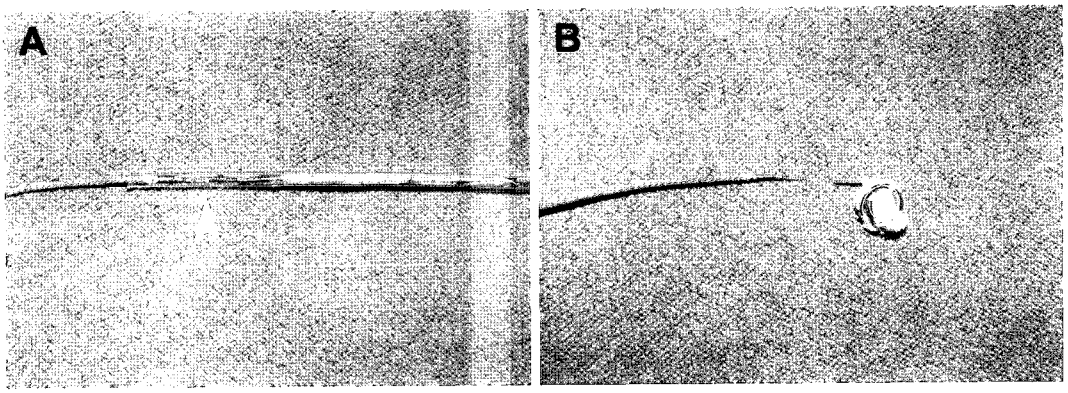

Fig 5. The transvenous embolization coil and delivery system used in this case. The embolization coils after release from the delivery system (8 mm in diameter, 4 loops). A : Attached to delivery system. B : Detached from delivery system.

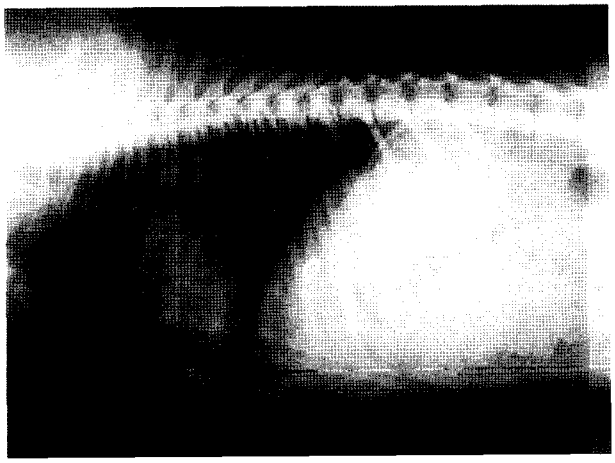

Fig 6. Abdominal radiography taken at 1 week after the transvenous coil embolization. The coil was still located at the same position where the coil was released.

an atropine (0.05 mg/kg, SC) and nalbuphine (0.5 mg/kg) followed by a propofol induction (20 mg/kg) and isoflurane maintenance. Heart rhythm, blood pressure, SpO_2, pCO_2 and rectal temperature were closely scrutinized using a patient monitor (VETSPEC VSM7, VetSpecs, Massachusetts, USA).

After achieving surgical anesthesia, the venipuncture was performed at right jugular vein with an 18G needle. A guide-wire (Fixed Core Wire Guides, Cook, Bloomington, USA) was inserted into the needle and located at the caudal vena cava. A 6F introducer sheath (Check-Flo Performer Introducer, Cook, Bloomington, USA) was then placed into the jugular vein along with the guide-wire. A 5F angiocatheter (Slip-Cath Beacon Tip Catheters, Cook, Bloomington, USA) was then inserted into the introducer sheath and located at the shunt with the guidance of fluoroscopy (Fig 4). A 8 mm embolization coil (4 loops; Flipper detachable embolization coils, Cook, Bloomington, USA; Fig 5A) was attached to a coil delivery system (Flipper Delivery Systems, Cook, Bloomington, USA; Fig 5B) and inserted into the angiocatheter, which was pre-placed at the shunt (Fig 4). After the coil was released at the shunt, the pre-place catheter and introducer were removed from the jugular vein (Fig 4).

On the clinical examination at the first day after the TCE, there was no serious complication associated with sudden increase of portal venous pressure such as endotoxemic shock, ascites. The location of coil was not changed on the radiography taken 1 week after TCE (Fig 6). Pre- and post-prandial serum bile acid levels were gradually reduced after the TCE (Table 1). The QT prolongation was disappeared after TCE (QTc = 246 msec). The dog is currently fed with 60% prescription diet (Hill's l/d) and 40% normal maintenance diet and is re-medicated with metronidazole (15 mg/kg, PO, q 12 hrs), lactulose (0.5 ml/kg PO, q 12 hrs) and S-adenyl methionine (20 ml/kg, PO, q 12 hrs).

Discussion

IPSS are classified as left, central, or right sided. Left-sided IPSS, or patent ductus venosus, are usually located in the left lateral or medial hepatic lobes, whereas central divisional IPSS are located within the right medial hepatic lobes and right divisional shunts are found in the right lateral liver lobe [8]. Because the left divisional IPSSs (patent ductus venosus) are consistent, each having a straight vessel which drains into a venous ampulla before draining into the caudal vena cava at the level of the diaphragm [8]. Our angiographical studies showed that the cause of IPSS for this case might be due to the persistent presence of ductus venosus after birth. Although more meticulous angiography was required to define the type of IPSS for this case, further angiography was not performed due to higher risk of general anesthesia for liver diseases.

Surgery for intrahepatic shunt is much more difficult than extrahepatic shunt. Intrahepatic PSS can be divided two divisions. Left hepatic division can be occluded by direct PSS ligation or by ligation of the left hepatic vein. Central and right hepatic divisions are often occluded by ligation of the associated portal vein branch. However, surgical ligation methods have several disadvantages (e.g. longer anesthetic

Table 1. Hematological and blood biochemical findings of this case

	Reference range	12 day before	1 day before	3 day after	1 week after	3 weeks after
WBC ($10^3/\mu L$)	6-17	10.0	20.3	14.4	10.3	14.7
Hemoglobin (g/dL)	12-18	10.1	11.4	12.5	11.9	13.5
HCT (%)	37-55	31	34	44	42	45
MCV (fL)	60-77	48.6	55.3	60.1	67.0	71.2
MCHC (g/dl)	33-36	35.4	35.7	34	28.3	30
RBC ($10^{12}/\mu L$)	5.5-7.5	5.88	5.77	6.11	6.27	6.32
Platelets ($10^3/\mu L$)	150-500	218	255	250	200	250
Total protein (g/dl)	5.5-7.5	3.9	4.3	ND*	5.3	ND
AST (U/L)	1-50	42	ND	55	ND	35
Creatinine (mg/dL)	0.9-1.7	0.5	0.6	0.7	0.6	0/7
Albumin (g/dL)	2.7-3.5	2.5	1.7	2.5	2.7	2.7
ALP (U/L)	20-300	145	228	181	128	81
ALT (U/L)	3-100	38	56	190	156	90
BUN (mg/dL)	7-28	6	9	12	16	12
APTT (sec)	22-40	20	20.9	ND	21.7	ND
PT (sec)	10-14	10	7.95	ND	7.95	ND
Cholesterol (mg/dL)	126-350	125	ND	244	ND	290
Pre-prandial bile acid (μmol/L)	0-10	130	ND	70	50	20
Post-prandial bile acid (μmol/L)	0-25	>250	>250	120	67	30
NH3 (ug/dl)		ND	220	ND	ND	ND

WBC, white blood cell; HCT, hematocrit; MCV, mean corpuscular volume; MCHC, mean corpuscular hemoglobin concentration, RBC, red blood cell; AST, aspirate transaminase; ALP, alkaline phosphatase; ALT, alanine transaminase; BUN, blood urea nitrogen; APTT, activated partial thrombin time; PT, prothrombin time. *ND: Not done

time, requiring wider range of surgical field). Transvenous coil embolization (TCE) has advantage over surgical methods, since this method does not require invasive surgery. Successful applications for IPSS have been well described in human literatures (5,6,9). However TCE is a relatively new technique in veterinary medicine and only a few case studies have been published in veterinary literature (1,3,7). TCE is minimally invasive, allows simultaneous angiography and portal pressure measurements, and minimizes potential complications associated with traditional surgical techniques. Potential risk of TCE includes aberrant coil migration into the heart or lungs. Furthermore TCE requires technical expertise and equipment (e.g. fluoroscopy).

In this case, the shunt diameter was too large to be fixed by single coil embolization. Although we initially planned to lodge a helical shaped tornado coil (tapered 2 to 10 mm in diameter), we did not use this coil, because of expected complications associated with sudden occlusion of PSS. Furthermore the connection between portal vein and caudal vena cava was concaved (much smaller than the actual shunt vessel). Although aberrant coil migration due to inappropriate coil embolization (e.g. inaccurate selection of coil, inappropriate coil placement) has been described in literature, single 8 mm coil placement was enough to alleviating clinical signs without coil migration, thanks to concaved (narrowed) connection between portal vein and caudal vena cava.

In conclusion, this case study described successful treatment of IPSS in a Samoyed dog using single transvenous coil embolization. Although this was successful case of TCE for IPSS, more studies (e.g. complications related to TCE, long-term management skills related to the staged occlusion by TCE and long term prognosis) are still warranted to apply this method more widely.

Acknowledgements

This study was supported by Research fund from Korean Research Foundation (KRF-2007-331-E00369).

References

1. Gonzalo-Orden JM, Altonaga JR, Costilla S, Gonzalo Cordero JM, Millan L, Recio AO. Transvenous coil embolization of an intrahepatic portosystemic shunt in a dog. Vet Raiol Ultrasound 2000; 41: 516-518.
2. Johnson CE, Crisp SM, Smeak DD, Fingeroth JM. Hepatic encephalopathy in two aged dogs secondary to a presumed congenital portal-azygos shunt. J Am Anim Hosp Assoc 1989; 25: 129.
3. Leveillee R, Pibarot L, Soulez G, Wisner ER. Transvenous coil embolization of an extrahepatic portosystemic shunt in a dog: a naturally occurring model of portosystemic malformations in humans. Pediatr Radiol 2000; 30: 609.

4. Mathews KG, Bunch SK. Vascular liver diseases. In: Ettinger SJ, Feldman EC (eds.). Textbook of Veterinary Internal Medicine. 6th. pp. 1453-1464. ELSEVIER SAUNDERS, Philadelphia, 2005.
5. Morse SR, Clark RA, Puffenbarger A. Platium microcoils for therapeutic embolization: non-neuroradiologic applications. AJR Am J Roentgenol 1990; 155: 401-403.
6. Okada Y, Endo T, Kusano S, Yoshida M. Multiple intrahepatic portohepatic venous shunts: treatment with steel-coil embolization. AJR Am J Roentgenol 1991; 157: 971-973.
7. Partington BP, Partington CR, Biller DS, Toshach K. Transvenous coil embolization for treatment of patent ductus venosus in a dog. J Am Vet Med Assoc 1993; 202: 281-284.
8. Tobias KM, Byarlay JM, Henry RW. A new dissection technique for approach to right-sided intrahepatic portosystemic shunts: anatomic study and use in three dogs. Vet Surg 2004; 33: 32.
9. Wallace S, Gianturco C, Anderson JH, Goldstein HM, Davis LJ, Bree RL. Therapeutic vascular occlusion utilizing steel coil technique: clinical applications. AJR Am J Roentgenol 1976; 127: 381-387.

샤모예드종 개에서 발생한 간내성 문맥-정맥 문합을 경정맥 코일장착으로 치료한 증례

이무현 · 이승진* · 이승곤 · 문형선 · 이준석 · 최란 · 박인철 · 현창백[1]**

강원대학교 수의학부 대학 소동물 내과교실, *울산 이승진 동물병원
**강원대학교 수의학부 대학 진단방사선 교실

요 약 : 5개월령 암컷 샤모에드종 개가 운동 불내성과 간성뇌증과 관련된 신경증상으로 내원하였다. 임상검사상 간혈적 발작, 빈혈, 식전/식후 담즙산 농도 상승, 저단백혈증 및 빌리루빈뇨증이 관찰되었다. 진단영상검사에서 간내 문정맥 문합이 확인되었다. 문합이 일어난 문맥혈관을 경정맥을 통한 embolization coil을 이용하여 성공적으로 폐색시켰다. 환자의 임상증상은 점진적으로 개선되었다. 본 증례는 대형품종 개에서 발생한 간내 문정맥 문합을 embolization coil을 이용하여 성공적으로 치료한 증례이다.

주요어 : 문정맥 문합, 코일, 경정맥, 개, 간질환