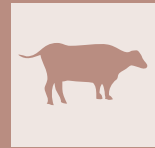


Evaluation of marsupialization combined with long-term administration of antibacterial agents in calves with omphalophlebitis and secondary liver abscess



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SUMMARY

Umbilical vein marsupialization was performed on three calves with abscesses of the umbilical vein and liver as revealed by ultrasonography. After surgery, the umbilical vein was washed with a warm physiological saline containing a susceptible antibacterial agent, and a systemic antimicrobial agent was administered for 14 days. There were no postoperative complications in any of the three calves, and each returned to production.

KEY WORDS

Antibacterial agent, calf, liver abscess, marsupialization, omphalophlebitis.

INTRODUCTION

Bacterial infections of the umbilical region of calves develop soon after birth due to insanitary birthing environments, failure of passive immunity, or incomplete disinfection of the umbilical cord¹. Infectious diseases of the umbilical region consist of umbilical cord inflammation outside the abdominal cavity, omphalophlebitis, umbilical arteritis, and urachal infection. Pathological progression eventually leads to abscess formation. Resultant bacteremia caused by these diseases may lead to complications (i.e. polyarthritis, pneumonia), and subsequently, reduce the productivity of calves. The umbilical arteries are transected and involute into the abdominal cavity during parturition; however, the umbilical vein and urachus lack elastic fibers and do not involute easily, facilitating the establishment of infections. Of the 322 cases of umbilical cord diseases, Yanmaz et al.² reported omphalophlebitis to be among the most intractable, inducing the highest mortality among calves.

A delay in the diagnosis and treatment of the umbilical vein infection leads to umbilical vein abscesses requiring drainage through marsupialization of umbilical vein (MUV), as abscesses reaching the porta hepatis are difficult to remove. Presently, there is no effective treatment method for managing the clinical progression of the disease and the eventual spread of the abscesses to the porta hepatis, because the removal of abscesses from within the liver parenchyma is challenging.

The present study reports on the satisfactory outcome of MUV, and long-term, post-surgical administration of antibacterial agents on three calves in which liver abscesses, secondary to omphalophlebitis, were observed.

MATERIAL AND METHODS

Three calves with omphalophlebitis involving the liver were treated surgically by marsupialization of the umbilical remnant. The medical records were reviewed to identify the breed, sex, age, bacterium isolated from the abscess, post-operative management including the duration and type of antibacterial agent administered, and the day from surgery to discharge (Table 1). Written informed consent was obtained from the respective owner for publication of this case report and accompanying images.

RESULTS

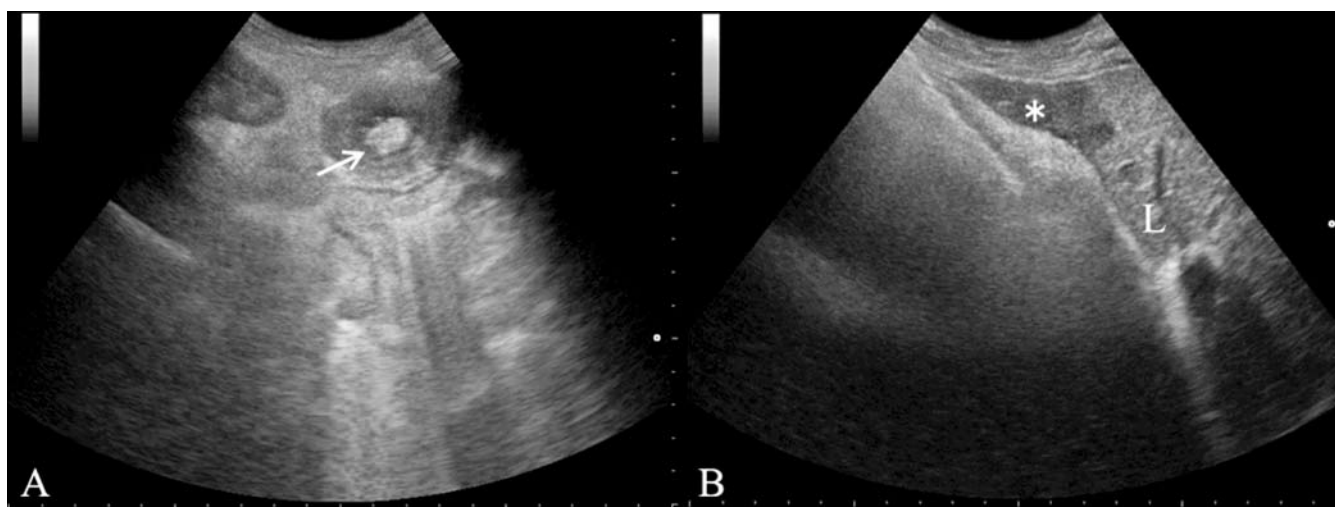
Case 1

Holstein, female, 4 months old; body weight (BW), 134.5 kg. The calf exhibited swelling of the umbilical region at approximately 1 month of age. As the owner observed no other abnormalities, no action was taken, and breeding was continued. At 4 months of age, the owner observed abscess drainage from the umbilical region and requested a diagnosis. The following observations were registered from the initial examination of the calf: a temperature of 39.3°C, heart rate of 102 bpm, respiratory rate of 66 bpm, satisfactory movement of the rumen, and no complaints with appetite or activity. The umbilical region was distended to 13x7x7 cm with abscess drainage observed from the tip. Fever was present and tenderness was found on palpation. A blood test showed an increase in leukocytes (13,700/ μ l; reference range, 4,900-12,000/ μ l). An ultrasound (3.5-MHz convex probe; MyLab One VET, Esaote, Maastricht, Netherlands) revealed a tubular structure linking the umbilical region to the liver (Figure 1A, 1B). Moreover, multiple high echogenicity spots (0.5-1 cm diameter) were imaged in a number of locations in the liver parenchyma. No abnormalities were observed in the

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Table 1 - Patient characteristics (breed, age, bacteria, therapeutic procedures).

Case No.	Breed	Sex	Age (month)	BW (kg)	Isolated Bacterium	Therapeutic			Days from surgery to discharge (day)
						Antibacterial agent	Period of Antibacterial agent administration (day)	Irrigation period (day)	
1	Holstein	female	4	134.5	T. pyogenes	PC	14	5	30
					P. mirabilis	KM			
2	Japanese Black	male	1	50.0	T. pyogenes	PC	14	4	25
					P. mirabilis	KM			
3	Brown Swiss	female	1	53.0	T. pyogenes	PC	14	5	23

**Figure 1** - Ultrasound image of the cranial abdomen of case 1. (A) Scanner placement transverse plane immediately cranial to the umbilicus. The lumen of the vein has an area of relatively high echogenicity (arrow). (B) The infected umbilical vein (*) penetrating the liver parenchyma (L).

umbilical arteries or the urachus. Collectively, these results presented a diagnosis of omphalophlebitis and secondary hepatic abscesses.

Aerobic and anaerobic culturing of the aseptically collected samples from the abscess leakage were conducted. Drug susceptibility tests (BD Sensi-Disc, Becton Dickinson Japan, Tokyo, Japan) were performed on the isolated bacteria using penicillin (PC), ampicillin (ABPC), cefazolin (CZ), oxytetracycline (OTC), kanamycin (KM) and enrofloxacin (ERFX).

Trueperella pyogenes (*T. pyogenes*) and *Proteus mirabilis* (*P. mirabilis*) were isolated from the abscess samples and were found to be susceptible to CZ, KM, and ERFX. Additionally, *T. pyogenes* showed susceptibility to PC and OTC; and *P. mirabilis*, to ABPC. Judging complete removal of the umbilical vein abscess to be problematic, MUV was implemented on the 3rd day following admission.

The cow was fasted for 24 h prior to the surgery, and intramuscular cefazolin sodium was administered (5 mg/kg, Cefazolin-Chu; Fujita Pharmaceutical, Tokyo, Japan) to prevent perioperative infection. The calf was guided to a recumbent, dorsal position before general anesthesia was administered. Following closure of the umbilical opening with purse-string sutures, a local anesthetic (Kyoritsu Seiyaku Corporation, Tokyo, Japan) with procaine hydrochloride was applied to the surgical site. The skin was incised in a fusiform shape around the umbilical opening, and following the separation of the umbilical region and the subcutaneous tissue, a sterilized surgical glove

was placed over the umbilical region. Nylon suture (USP-3) was used to ligature the exposed umbilical cord and glove and, thereby, prevent leakage from the umbilical opening.

An incision was made of the skin, 5 cm toward the cranial side from the umbilical region and, 1.5 cm paramedially on the right side, and approximately 10 cm towards the cranial side. The swollen umbilical vein, proceeding from the abdominal cavity, was made to adhere to the peritoneum and the greater omentum, and subsequently, connected to the liver. After circular excision of the umbilical stump, the freed umbilical vein was tugged to the right of the paramedian site while retaining the cranial end of the incisional site. Following closure of the umbilical region (median plane) with synthetic, absorbent sutures; the swollen umbilical vein was clipped in place near the porta hepatis using intestinal clamps. A warm, physiological saline solution, containing 2 g of dissolved cefazolin sodium, was then slowly and repeatedly infused in, and suctioned out from the umbilical vein, held outside the abdominal cavity, until the solution became clear. The clips near the porta hepatis were then released. The small, paramedian opening was sutured shut from the caudal section, and the freed umbilical vein was fixed in place by suturing it to the tunica muscularis at the cranial tip of the opening. The skin incision was ligatured with intradermal, buried sutures using synthetic, absorbent thread.

Procaine penicillin G (5,000 IU/kg, Kyoritsu Seiyaku Inc., Tokyo, Japan) and kanamycin (10 mg/kg, Ryusan Kanamycin-

Chu 100, Kyoritsu Inc., Tokyo, Japan) were administered for 14 days, following the surgery. On the 5th day post-surgery, physiological saline solution was slowly infused in and suctioned out from the umbilical vein opening without applying pressure, and irrigation was performed until the solution appeared clear. Two weeks after the surgery, the umbilical vein was removed, and abdominal closure was performed. The calf was released from care 30 days following the initial surgery and delivered her first calf 25 months post-surgery. At 32 months, she continued to undergo breeding.

Case 2

Japanese black cattle, male, 1 month old; BW, 50 kg. The calf was examined 25 days after birth due to insufficient appetite and abscess drainage from the umbilical region. The initial examination showed a temperature of 39.2°C, heart rate of 102 bpm, respiratory rate of 22 bpm, and sluggish activity. The umbilical region was distended to 5x4x4 cm. Fever and tenderness were observed on palpation, with induration in one area. Deep palpation of the calf in the standing position detected an egg-sized swelling from the umbilical cord in the right cranial direction. A blood test evinced a mild increase in leukocytes (12,700/ μ l; reference range, 4,900-12,000/ μ l). An ultrasound revealed a tubular structure linking the umbilical region to the liver. Moreover, large, unequal echogenicity spots of 0.5 cm diameters were identified at a number of locations in the liver parenchyma. No abnormalities were observed in the umbilical arteries or the urachus. Collectively, these results presented a diagnosis of omphalophlebitis and a secondary hepatic abscess.

Aerobic and anaerobic culturing of the abscess drainage were conducted; as in Case 1, *T. pyogenes* and *P. mirabilis* were isolated. A drug susceptibility test showed that both bacteria were susceptible to ABPC, CZ, KM and ERFX. Additionally, *T. pyogenes* showed susceptibility to PC.

Judging complete extraction of the umbilical vein abscess to be problematic, MUV was performed on the 14th day after admission. The same methods for pre-surgical management and surgical operations, employed in Case 1, were applied to this case. The swollen umbilical vein proceeding out of the abdominal cavity was made to adhere to the peritoneum and the greater omentum and was then connected to the liver (Figure 2). Procaine penicillin G (5,000 IU/kg) and kanamycin (10 mg/kg) were administered for 14 days post-surgery. As in Case 1, saline solution with dissolved cefazolin was used for 14 days until it appeared clear after the irrigation of the umbilical vein opening.

Two weeks post-surgery, the umbilical vein was removed and abdominal closure was performed. On the 25th day following the surgery, the calf was released from care and was slaughtered for meat at the age of 30 months.

Case 3

Brown Swiss, female, 1 month old; BW, 53 kg. The calf was examined 14 days post-partum due to anorexia, umbilical region swelling, and abscess drainage. Initial examination showed a temperature of 39.7°C, heart rate of 130 bpm, respiratory rate of 48 bpm, and sluggish activity. The umbilical region was distended to 5x4x4 cm. Fever and tenderness were observed upon palpation, with induration in one area. A blood test showed an increase in leukocytes (15,400/ μ l; reference range, 4,900-12,000/ μ l) and hyperfibrinogenemia

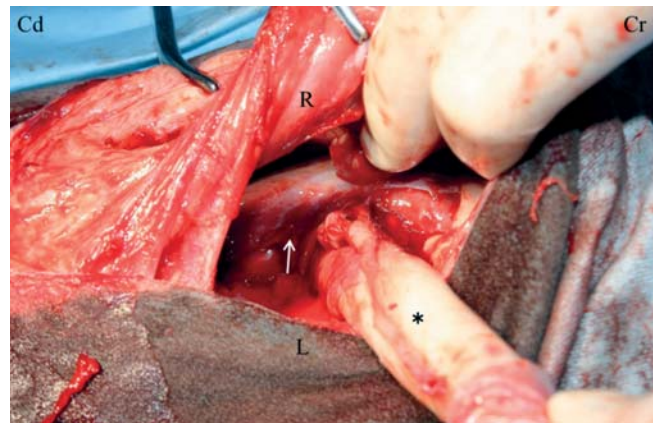


Figure 2 - Intraoperative appearance of the infected umbilical vein (*) penetrating the liver (arrow) of case 2. Cr, cranial; Cd, caudal; R, right side; L, left side.

(800 mg/100 ml, reference range, 400-700 mg/100 ml). An ultrasound revealed a tubular structure linking the umbilical region to the liver. Moreover, low echogenicity nodules (1 cm diameter) were scattered in the liver parenchyma. A contrast-enhanced computed tomography (CT; BrightSpeed16, GE Healthcare, Port Washington, NY, U.S.A.) was performed before surgery. Iohexol (Omnipaque; Daiichi-Sankyo Co., Ltd., Tokyo, Japan) was used as a contrast agent. Multiple unenhanced nodules, suggestive of intra-hepatic abscesses, were observed (Figure 3). No abnormalities were seen in the umbilical arteries or the urachus. From the ultrasound and CT examination, a diagnosis of multiple hepatic abscesses issuing from the umbilical vein was made.

Aerobic and anaerobic culturing of the abscess drainage were

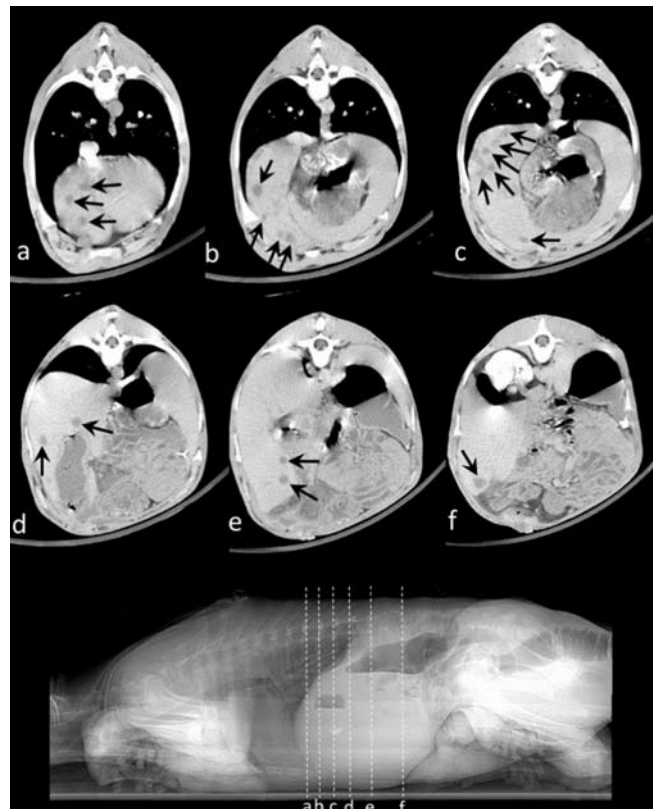


Figure 3 - Contrast enhanced computed tomography showed multiple hepatic abscess of case 3. Arrows show the multiple hepatic abscess.

performed as in Case 1, and *T. pyogenes* was isolated. A drug susceptibility test showed sensitivity of *T. pyogenes* to PC, ABPC, CZ, KM, OTC, and ERFX.

Judging complete extraction of the umbilical vein abscesses to be problematic, MUV was implemented on the 4th day after admission. The same pre-surgical management and surgical operations used in Case 1 were applied to this case. The swollen umbilical vein proceeding from outside the abdominal cavity was made to adhere to the peritoneum and the greater omentum, and was subsequently, connected to the liver. Procaine penicillin G (5.000 IU/kg) was administered for 14 days post-surgery. To irrigate the umbilical vein opening, as in Case 1, saline solution containing cefazolin was used for 5 days until it appeared clear. At 13 days post-surgery, the umbilical vein was removed, and abdominal closure was performed. On the 23rd day following the surgery, the calf was released from care. The cow continued breeding at 8 months of age.

DISCUSSION

Umbilical cord inflammation arising outside the abdominal cavity³⁻⁵, omphalophlebitis, umbilical arteritis, and urachal inflammation caused by diffusion of the infection within the abdominal cavity, generally comprise the infectious diseases of the umbilical region affecting newborn calves. Of the 322 cases of umbilical cord disease, Yanmaz et al.² reported omphalophlebitis as one of the most intractable diseases, and thus, induces the highest mortality among calves.

Omphalophlebitis progresses to septicemia, bacterial infectious diseases, and formation of hepatic abscesses, becoming an economically damaging disease⁶. Surgical removal of the umbilical vein is viable for cases of umbilical vein abscess without the involvement of the liver parenchyma. However, for abscesses penetrating the liver parenchyma, MUV is performed on account of the difficulty of partially removing the liver^{3,6-9}. When conducting MUV, two methods^{8,10,11} allow for the appropriate drainage^{4,10,12,13} of abscesses within the umbilical vein. Edwards et al.¹⁰ and Marchionatti⁸ have devised a new type of incision at the region where veins enters the liver (right, cranial abdominal wall), and have reported a method of fixing the umbilical vein thereto. This positioning allows the vein to exit the abdominal cavity directly ventral to the liver. Although the risk of introducing infected tissue and infecting the abdominal cavity is likely, covering the tip of the umbilical vein with a vinyl or a surgical glove can mitigate the risk.

Steiner et al.⁸ have reported a method of extending the umbilical vein, several centimeters from the xiphoid process, and fixing it to the cranial side of an incised wound on the caudal umbilical cord. Both methods require frequent drainage of the infection from within the umbilical vein. However, applying pressure when cleaning the umbilical vein increases the risk of further intra-hepatic progression of infection, and pressurized cleansing worsens the pathology and may induce septicemic shock and consequent death⁸.

The three cases herein presented used the Edwards et al.¹⁰ and Marchionatti¹¹ methods to drain the liver directly to the area outside the abdominal cavity. To prevent the expulsion of umbilical vein abscesses into the liver, the hepatic opening was clipped close with intestinal clamps prior to cleansing the umbilical vein with a warm, physiological saline solution, repeatedly infused and suctioned out without applying pressure.

In addition, while inflammatory bacteria and bacterial liver abscesses can be treated by abscess drainage and the administration of an appropriate antibacterial agent, intractable bacterial liver abscesses accompanying chronic granulomatous disease can reportedly be treated with a satisfactory prognosis by combining percutaneous trans-hepatic abscess drainage with long-term administration of antibacterial agents¹⁴.

CONCLUSIONS

In the three cases herein reported, the performance of MUV and pre-surgical bacterial investigations, and post-surgical, long-term administration of antibacterial agents can be considered to enable post-surgical recovery of productivity, free of secondary diseases. However, owing to the considerable risk of a superinfection and the emergence of resistant bacteria when administering antibacterial agents, the inflammatory bacteria must be treated, antibacterial agents with corresponding susceptibility be used, and monitoring for the possibility of resistant bacteria be maintained. This research suggests that MUV and long-term administration of antibacterial agents can be used to effectively treat omphalophlebitis and the secondary hepatic abscesses.

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