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Treatment of pyogenic liver abscess with surgical incisions and drainage combined with platelet-rich plasma: A case report

Wang JH *et al*. Treatment of pyogenic liver abscess

Abstract

BACKGROUND

Pyogenic liver abscesses are insidious in the early stage. Some cases progress rapidly, and the patient's condition can worsen and even become life-threatening if timely treatment is not provided. Surgery and prolonged antibiotic treatment are often required if the abscess is large and liquefied and becomes separated within the lumen.

CASE SUMMARY

We report a case of bacterial liver abscess with a poor outcome following pharmacological treatment, review the literature related to the use of platelet-rich plasma (PRP) in the treatment of hepatic impairment and partial hepatectomy in animals, and discuss the prognostic features of surgical incision and drainage combined with PRP in the treatment of bacterial liver abscesses. This is the first case describing the use of PRP in the treatment of a bacterial liver abscess in humans, providing new ideas for the treatment of this condition.

CONCLUSION

This case highlights the importance of surgical treatment for bacterial liver abscesses that are well liquefied and poorly managed medically. Second, PRP may produce antimicrobial effects and promote the regeneration and repair of liver tissue.

Key Words: Pyogenic liver abscess; Surgical incision and drainage; Platelet-rich plasma; Case report

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Core Tip: Previously, pyogenic liver abscess was typically treated with antibacterial drugs, percutaneous puncture and drainage or surgical incision and drainage; surgical incision and drainage combined with platelet-rich plasma (PRP) has not been reported. By reviewing the relevant literature and combining the previously reported benefits of PRP on liver function improvement and liver tissue regeneration and repair, we treated a large abscess with good liquefaction and a poor response to antibacterial drug treatment with surgical incision and drainage combined with PRP in our hospital. The patient was discharged after 7 d of treatment without pus cavity flushing and no recurrence at follow-up. Therefore, we consider that PRP may have direct antimicrobial and promotional effects on liver tissue regeneration, but this needs to be confirmed with a larger sample and establishment of a clinical case–control study.

INTRODUCTION

The ageing of the population and the application of broad-spectrum antibiotics and immunosuppressive drugs in recent years have led to an increase in the incidence of pyogenic liver abscess (PLA). Early symptoms of PLA are often atypical; the disease is difficult to diagnose and progresses rapidly, with approximately 15% of patients developing sepsis and even life-threatening infectious shock due to a lack of timely

treatment. In some cases, PLA liquefaction is followed by separation, and anti-infective drugs combined with puncture drainage are ineffective, making surgical treatment necessary. Simple surgical incision and drainage require repeated double-cannula flushing after the procedure, which is inconvenient, requires prolonged postoperative antibacterial drug use and a long hospital stay, and is associated with a slow recovery.

In this study, we report a case of PLA treated with surgical incision and drainage combined with an injection of platelet-rich plasma (PRP). After the operation, the patient did not require double-cannula flushing or prolonged antibacterial drug administration. To date, no similar cases in the domestic or foreign literature have been identified.

CASE PRESENTATION

Chief complaints

A 67-year-old man visited the emergency department of our hospital for "repeated fever for more than 10 d". He did not present with any signs of abdominal pain or vomiting.

History of present illness

For more than 10 d, the patient had chills and fever (38.3 °C) due to a cold. The patient took some medication (unspecified by the patient), and his symptoms were slightly alleviated. He experienced repeated episodes of chills and fever in the afternoon, with a maximum body temperature of 38.8 °C, along with occasional nausea and vomiting of the gastric contents. His symptoms were not alleviated after vomiting or taking oral cold and flu medication. Therefore, he came to our hospital for further diagnosis and treatment. Abdominal computed tomography (CT) performed at the outpatient clinic revealed a liver abscess. The patient was admitted to the hospital for treatment on April 15, 2020. Since the onset of the disease, the patient had a poor appetite, his urine output was normal, and he did not lose a significant amount of weight.

History of past illness

The patient had a history of coronary stent implantation due to occlusion of the descending branch of the coronary artery (myocardial infarction) in 2008. After the operation, he began taking oral medication, including clopidogrel (Plavix) 75 mg qd, simvastatin 10 mg qd, and aspirin 100 mg qd. He discontinued the aspirin on his own accord one month prior to his visit. Additionally, his history included cerebral infarction, which occurred in 2019, and his muscle strength was rated grade 4 in the left arm and grade 3 in his left leg after admission to our hospital.

Personal and family history

The patient had no relevant personal or family history.

Physical examination

The patient was conscious with stable vital signs. Body temperature: 36.4 °C; pulse rate: 83 beats/min; respiratory rate: 20 breaths/min; blood pressure: 130/80 mmHg. His abdomen was soft, with tenderness in the right upper quadrant. No rebound pain was noted, and muscle tone was normal. The liver was not palpable under the costal margin. Percussive pain was induced in the liver region. No oedema was noted in either lower limb.

Laboratory examinations

Blood analysis revealed the following: White blood cells: 6.90 $\times 10^9$/L, medium cell percentage: 84.4%, haemoglobin: 122 g/L, platelets: 316×10^9/L. Procalcitonin: 0.61 ng/mL. Biochemistry: total protein: 70.3 g/L, albumin: 27.5 g/L, creatinine: 50.9 mol/L, urea nitrogen: 3.12 mol/L, prothrombin time: 15.6 s, percentage prothrombin activity: 57%, activated partial prothrombin time: 44.4 s, D-dimer 1.25 μg/mL. Routine urine and stool examination was normal. Electrocardiography and chest X-ray were also normal (Table 1).

Imaging examinations

CT images showed multiple low-attenuation masses with unclear boundaries in the right lobe of the liver. A lesion measuring 9 cm × 8 cm was located in the upper posterior segment of the right lobe. A diagnosis of liver abscess was considered (Figure 1).

FINAL DIAGNOSIS

Massive multilocular abscess in segments VI and VII of the right liver.

TREATMENT

After admission, the patient was given empirically provided intravenous ceftazidime (2 g every 12 h) as anti-infective therapy and 30 Kcal/(kg.d) of enteral and parenteral nutrition support (a full nutrition mixture). The patient's highest body temperature on the second day after admission was 37.5 °C. He had a poor appetite. Anti-infective therapy alone was not effective. After obtaining consent from the patient's family members, the following procedures were performed under general anaesthesia on April 21, 2020: incision, irrigation and drainage of the liver abscess, injection of PRP into the abscess cavity, and abdominal drainage. The intraoperative findings showed that the surface of the abscess cavity had adhered to the diaphragm and the abdominal wall. After separating the ligamentum teres hepatis, falciform ligament, and right triangular ligament, a 20-mL syringe was used to puncture the swollen hepatic surface. Whitish-grey pus was collected for bacterial culture, and an electronic scalpel was used to extend the incision and excise a portion of the tissue for pathological examination. Blunt separation was performed to separate the septa in the abscess cavity. After the pus was thoroughly drained and aspirated, the abscess cavity was rinsed with iodophor and normal saline. No bile leakage or bleeding was noted. One abdominal drainage tube was placed in the cavity to drain any newly formed pus. The abscess cavity was filled with 80 mL of prepared PRP. Haemostatic gauze was used to cover the operative field

to prevent leakage of the PRP; the gauze was secured along the edges of the cavity, completing the procedure (Figure 2). Intraoperative blood loss totalled 50 mL.

OUTCOME AND FOLLOW-UP

After the procedure, the patient did not have a fever. On the fourth postoperative day, *Klebsiella pneumoniae* (*K. pneumoniae*) was found in the drainage fluid culture, which was sensitive to ceftazidime. Anti-infective therapy was administered, and supportive treatment was continued. After a follow-up CT (Figure 4) was performed on April 24, 2020, the drainage tube was removed. On April 28, 2020, another CT examination was performed (Figure 5), antimicrobial treatment was discontinued, the sutures were removed, and the patient was discharged from the hospital. There has been no recurrence at follow-up visits 1 mo, 3 mo, 6 mo and 1 year after surgery.

DISCUSSION

PLA is a type of purulent inflammation of the liver caused by the invasion of pyogenic bacteria and is most often caused by bloodstream and biliary tract infections. The condition has an incidence of approximately 2.3 per 100000 and is more common in men than in women[1]. In recent years, as a result of the ageing of the population and an increase in basic diseases such as diabetes and malignant tumours, the incidence of PLA has increased annually. Most cases of PLA can be cured with a combination of percutaneous liver abscess puncture or drainage and antibacterial therapy. In cases of a separated abscess due to delayed diagnosis, the combination of antibacterial drugs and puncture treatment is often ineffective and has a poor prognosis, and surgery is necessary[2].

Traditional surgeries for treating PLA include surgical incision and drainage or partial hepatectomy. In this case study, the abscess was well liquefied, had a large surface area, and was separated; therefore, surgical drainage was indicated. After incision and flushing, we injected PRP to promote the growth of liver tissue in the cavity.

First developed in the 1990s, PRP is one of the most innovative autologous blood products used to promote tissue healing and regeneration. PRP is prepared by centrifuging blood drawn from one of the patient's peripheral veins and concentrating the platelets. The long-term effects of platelet activation are manifested by the expression of > 30 growth factors[3]. PRP contains three to five times more platelets (enriched) than basal plasma levels and elevated concentrations of autologous growth factors [*e.g.*, vascular endothelial growth factor (VEGF), insulin-like growth factor (IGF), platelet-derived growth factor, transforming growth factor β-1, hepatocyte growth factor (HGF), and basic fibroblast growth factor], proteins and peptides (*e.g.*, fibrinogen, fibronectin, osteonectin, osteocalcin, vitronectin, and thrombospondin), and certain chemokines and cytokines (*e.g.*, interleukin-1 and platelet factor 4)[3]. Therefore, many PRP types have been used by clinicians for many years due to their advantageous effects on wound healing, cellular mitogenesis, osteogenesis, and angiogenesis[4]. It also bestows beneficial effects on increasing tissue regeneration, lowering infection due to the antibiotic-like action of the included leukocytes, and decreasing pain and blood loss[5].

PRP infusion causes notable liver regeneration in experimental animal models of liver dysfunction. This was validated by a significant decrease in liver enzymes (serum aspartate aminotransferase, alanine aminotransferase, gamma glutamyl transferase and serum lactate dehydrogenase). PRP provides significant protection against liver fibrosis mainly *via* antifibrotic, antiapoptotic, and anti-inflammatory pathways[5,6]. Immediate contact between platelets and hepatocytes can evoke the release of soluble factors from platelets, such as IGF-1 and HGF, which are considered crucial mediators of liver recovery[7]. It was also found that exogenous platelets improve liver recovery. Furthermore, growth factors, such as IGF-1, VEGF, and HGF, contribute to hepatocyte proliferation induced by platelets[8] and promote hepatocyte mitosis, which eventually enhances liver recovery.

Oxidative stress is caused by a shift in the balance between oxidants and antioxidant cytokines and is caused by the overproduction of reactive oxygen species (ROS)[5]. A

balance between ROS and the main antioxidant products (superoxide dismutase, catalase and glutathione peroxidase) is needed to avoid damage from oxidative stress[5]. Partial hepatectomy causes liver injury and tissue loss due to an increase in ROS, which can lead to a reduction not only in cell growth but also in mitotic activity by inhibiting proteins of the cell cycle and disrupting DNA synthesis[9-11]. Histopathological analysis in rats after partial hepatectomy showed that PRP did not provide any tissue improvement in liver regeneration but significantly reduced oxidative stress-induced apoptosis (9).

Under normal physiological conditions, a variety of components in platelets act synergistically on local cells, producing a haemostatic effect; additionally, they stimulate the proliferation, differentiation, and migration of damaged tissue cells; promote collagen matrix deposition and vascular regeneration at the damaged site; shorten the bleeding, inflammation, and proliferation phases of the wound repair process; promote the proliferation and differentiation of cells in the muscle and vascular systems; accelerate epidermal growth in the wound; and promote the repair of damaged tissues and wound healing[12]. Compared with whole blood, PRP generally has 3-5 times more growth factors and differentiation factors[13]. Approximately 70% of the growth factors in PRP are activated within 10 min, and almost 100% are released within 1 h. Very few growth factors are released during the platelet survival period (8-10 d); this may be related to the rapid patient recovery and absence of fever after surgery.

Empirical anti-infection treatment can be provided if effective pathogens cannot be identified during the early stage of PLA. In China, PLA is most often caused by *K. pneumoniae* (accounting for 77.1% of all cases)[1]. Based on experience, third-generation cephalosporins, fluoroquinolones, carbapenems, and aminoglycosides are often used in the early stage of PLA[14]. Specific antibacterial drugs can be selected in the later stage based on drug sensitivity. For the case in this study, ceftazidime was used as an anti-infection treatment for 6 d before surgery. Cultures of intraoperatively collected specimens suggested the involvement of *K. pneumoniae*, which is sensitive to

ceftazidime. Three days after surgery, all of the patient's indicators were normal. The intravenous infusion of antibacterial drugs was continued for 7 d, and no oral antibacterial drugs were administered. CT performed 14 d after discharge showed that the patient was recovering well. Related literature indicates that antibacterial treatment for PLA should be provided for 4-6 wk[15]. The patient in this case had a significantly shorter duration of antibacterial treatment. The main considerations for treatment are the complete removal of liquefied necrotic tissue during surgery and the activation of a large number of anti-inflammatory cytokines *via* PRP injection. Our treatment method effectively removed harmful bacteria in a timely manner[14].

To date, PRP has been utilized as a part of therapeutic and surgical approaches in numerous fields, including dentistry, orthopaedics, neurosurgery, ophthalmology, and maxillofacial and cosmetic surgery[16]. A literature review did not yield any reports on the use of PRP in abdominal surgery. Considering that the abdominal cavity is closed, it is necessary to ensure absolute sterility. We found reports on the use of PRP in diseases related to assisted reproduction[17], which provides reliable evidence to support its application in abdominal surgery. After consulting the literature and mastering the basic principles of PRP, we invited experienced physicians from the dermatology department of our hospital to prepare PRP under strictly aseptic conditions to ensure its quality. In this first application of this procedure, the surgeon and the physicians who prepared the PRP independently and reliably performed their duties. The PRP was prepared when needed to avoid prolonged storage and ensure quality. The patient recovered well and was discharged from the hospital 7 d after the operation, and he was followed up for 1 year without recurrence. However, this study only comprised one case. Whether PRP can accelerate the recovery of PLA must be further confirmed by studies with a large sample. Our treatment used traditional laparotomy for open drainage to allow complete flushing and accurate injection of the PRP. After the technology has been mastered, we plan to adopt a minimally invasive endoscopic approach for incision and flushing and to use a trocar channel for PRP injection to reduce the pain from the surgical incision and accelerate patient recovery.

CONCLUSION

Previously, PLA was typically treated with antibacterial drugs, percutaneous puncture and drainage or surgical incision and drainage; surgical incision and drainage combined with PRP has not been reported. By reviewing the relevant literature and combining the previously reported benefits of PRP on liver function improvement and liver tissue regeneration and repair, we treated a large abscess with good liquefaction and a poor response to antibacterial drug treatment with surgical incision and drainage combined with PRP in our hospital. The patient was discharged after 7 d of treatment without pus cavity flushing and no recurrence at follow-up. Therefore, we consider that PRP may have direct antimicrobial and promotional effects on liver tissue regeneration, but this needs to be confirmed with a larger sample and establishment of a clinical case–control study.

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