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Hepatic artery stent-grafts for the emergency treatment of acute bleeding

Nadine Bellemann[a,*], Christof-Matthias Sommer[a], Theresa Mokry[a], Nikolas Kortes[a], Daniel Gnutzmann[a], Theresa Gockner[a], Anne Schmitz[a], Jürgen Weitz[b,c], Hans-Ulrich Kauczor[a], Boris Radeleff[a], Ulrike Stampfl[a]

[a] Department of Diagnostic and Interventional Radiology, University Hospital Heidelberg, INF 110, 69120 Heidelberg, Germany
[b] Department of Surgery, University Hospital Heidelberg, INF 110, 69120 Heidelberg, Germany
[c] Department for Visceral, Thoracic and Vascular Surgery at the University Hospital, Technical University Dresden, Germany

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ABSTRACT

Purpose: We evaluated the technical success and clinical efficacy of stent-graft implantation for the emergency management of acute hepatic artery bleeding.
Methods: Between January 2010 and July 2013, 24 patients with hemorrhage from the hepatic artery were scheduled for emergency implantation of balloon expandable stent-grafts. The primary study endpoints were technical and clinical success, which were defined as successful stent-graft implantation with sealing of the bleeding site at the end of the procedure, and cessation of clinical signs of hemorrhage. The secondary study endpoints were complications during the procedure or at follow-up and 30-day mortality rate.
Results: In 23 patients, hemorrhage occurred after surgery, and in one patient hemorrhage occurred after trauma. Eight patients had sentinel bleeding. In most patients ($n = 16$), one stent-graft was implanted. In six patients, two overlapping stent-grafts were implanted. The stent-grafts had a target diameter between 4 mm and 7 mm. Overall technical success was 88%. The bleeding ceased after stent-graft implantation in 21 patients (88%). The mean follow-up was 137 ± 383 days. In two patients, re-bleeding from the hepatic artery occurred during follow-up after 4 and 29 days, respectively, which could be successfully treated by endovascular therapy. The complication rate was 21% (minor complication rate 4%, major complication rate 17%). The 30-day mortality rate was 21%.
Conclusions: Implantation of stent-grafts in the hepatic artery is an effective emergency therapy and has a good technical success rate for patients with acute arterial hemorrhage.

1. Introduction

In the recent years, stent-grafts and their delivery systems have been improved for the application in peripheral and visceral vessels. Since then, they have been increasingly used for the treatment of arterial hemorrhage in these vascular territories. Bleeding that requires stent-graft implantation in the hepatic artery can be caused by several underlying conditions. In most cases it occurs in the postoperative period after pancreatic surgery or liver transplantation, especially in the presence of an intraabdominal abscess, pancreatic fistula, anastomotic leakage or during thrombolysis for the treatment of hepatic artery thrombosis. Hemorrhage-related complications are reported in 2–5% of patients undergoing pancreaticoduodenectomy, and the gastroduodenal artery stump is the most common site of hemorrhage in patients with leakage of the pancreaticoenteric anastomosis [1]. Recently, definitions for postoperative hemorrhage after pancreatic or liver surgery have been implemented that grade this complication [2,3]. Furthermore, hemorrhage from the hepatic artery can be caused by vessel erosion in patients with pancreatitis [4,5].

At our hospital, the implantation of balloon expandable stent-grafts in the hepatic artery is part of an emergency protocol for the endovascular management of acute hemorrhage. Often, stent-graft implantation represents the only treatment option in patients with hemorrhage from the hepatic artery, because coil embolization is not feasible without occluding the hepatic artery, and the patients are in critical clinical conditions and therefore no good candidates

* Corresponding author. Tel.: +49 6221 5637082.
E-mail addresses: nadine.bellemann@med.uni-heidelberg.de, nadine.bellemann@web.de (N. Bellemann).

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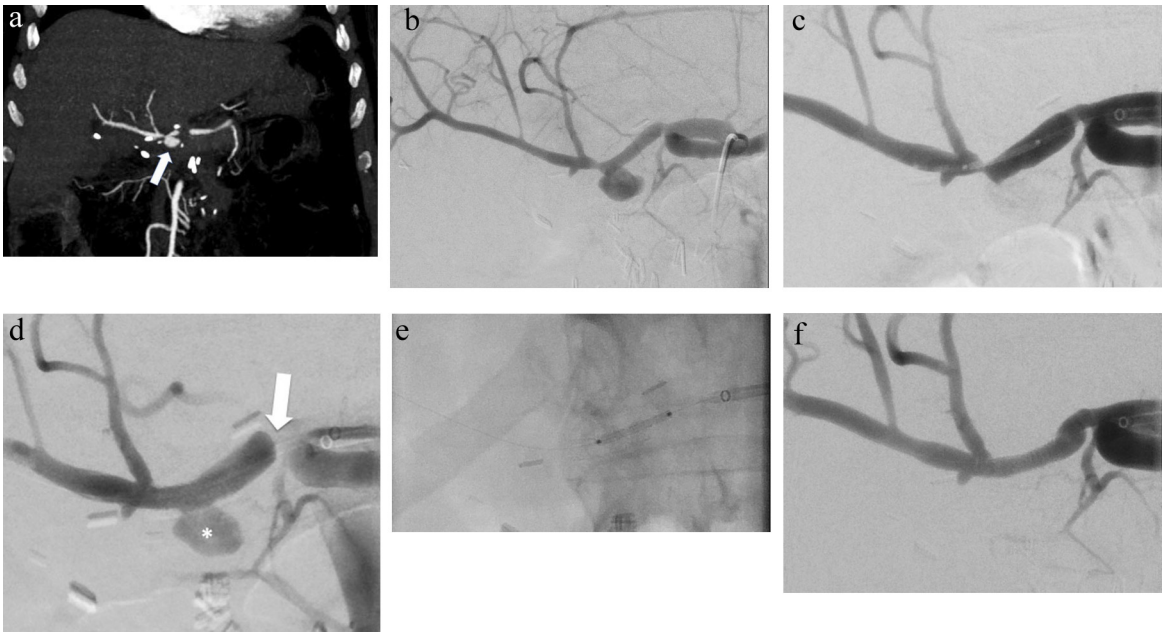

Fig. 1. (a) Pseudoaneurysm (arrow) of the proper hepatic artery after pylorus-preserving pancreaticoduodenectomy. MDCT (coronal orientation). (b) Celiacography demonstrates the pseudoaneurysm of the hepatic artery. (c) Angiogram during stent-graft placement (Graftmaster, diameter 4 mm, length 19 mm) in the proper hepatic artery close to the origin of the left hepatic artery. 5 F sheath in the celiac trunk. (d) Angiographic control after stent-graft implantation in the proper hepatic artery. The pseudoaneurysm (*) is still perfused via a type I endoleak. Proximal spasm of the hepatic artery (arrow). (e) A second stent-graft (Graftmaster, diameter 5 mm, and length 19 mm) is advanced into the hepatic artery. (f) Angiography after implantation of the second stent-graft. The pseudoaneurysm is sealed. The spasm has resolved after administration of 200 μg nitrolingual.

for surgery. Here, we present the results of stent-graft implantation in the hepatic artery in patients with acute arterial hemorrhage. The primary study endpoints were technical success, defined as stent-graft placement with sealing of the bleeding site at the end of the intervention, and clinical success. The secondary study endpoints were complications during the procedure or at follow-up and the 30-day mortality rate.

2. Materials and methods

2.1. Patients

Institutional review board approval was obtained for this retrospective study. Between January 2010 and July 2013, 24 patients (19 male, 5 female, mean age 62 ± 11 years, range 39–80 years) with clinical signs of acute hemorrhage (e.g., drop of hemoglobin, requirement of red blood cell units, tachycardia, hemorrhagic shock) and identification of the hepatic artery or, in patients who underwent pancreaticoduodenectomy, the gastroduodenal artery stump as the site of hemorrhage were scheduled for emergency stent-graft implantation. The number of patients with sentinel bleeding after pancreatic surgery was noted. According to the International Study Group of Pancreatic Surgery, sentinel bleeding often precedes massive hemorrhage and is described as onset of discrete, but evident blood loss, e.g. via abdominal drains with a decrease of hemoglobin concentration ≤1.5 g/dL [2].

2.2. Interventional procedure

All interventions were performed either under general or local anesthesia with additional analgesic medication if necessary. Patients gave informed consent, if this was possible with respect to their clinical situation.

In patients with onset of hemorrhage during thrombolytic therapy of the hepatic artery, a catheter was already placed in the hepatic artery. In the other patients, a preinterventional multidetector computed tomography (MDCT, non-enhanced, arterial and venous phase, administration of 130 mL of contrast agent, Somatom Definition DS, Siemens, Erlangen, Germany) was performed for exact detection of the bleeding site (defined as extravasation of contrast agent or pseudoaneurysm) and procedure planning. Also, anatomical variations of the liver perfusion were detected by the preinterventional MDCT. Additional to angiography, preinterventional MDCT was used to delineate the exact extent of the vascular injury. Especially in patients with postoperative vessel erosion due to anastomotic leakage or pancreatic fistula, it is important to cover the complete length of the eroded vessel (Fig. 1).

According to the preinterventional MDCT and the site of hemorrhage, the vascular access was chosen (transfemoral access vs. transbrachial access depending on the anatomic conditions). A 4 F sheath was initially placed either in the femoral artery or in the brachial artery depending on preinterventional procedure planning. Then, the celiac trunk or, in patients with anatomical variations, the superior mesenteric artery was selectively catheterized, and a celiacography or mesentericography was performed.

Preinterventional MDCT and angiography determined the appropriate diameter and length of the stent-graft. We used two different types of ballon expandable stent-grafts in our study, which are both covered with polytetrafluoroethylene (PTFE): In vessels with a diameter up to 5 mm, we chose Jostent Graftmaster stent-grafts (Abbott, Rangendingen, Germany). In vessels with a diameter of 6 mm or larger, we chose Advanta V12 stent-grafts (Atrium Medical Corporation, Hudson, New Hampshire, USA). The adequate length of the stent-graft was measured on the preinterventional MDCT and the angiography. The length of the stent-graft was planned to completely cover the site of hemorrhage and also the adjacent eroded vessel segment. A 5–7 F sheath (Destination, Terumo, Leuven, Belgium, or Super Arrow-Flex, Arrow Int., Reading, PA, USA) was placed in the celiac trunk or the superior mesenteric artery. The hepatic artery was catheterized, and a 0.014″ wire (Skipper guidewire, Invatec, Italy) for implantation of the Jostent Graftmaster stent-grafts or a 0.035″ Amplatz super stiff wire