Percutaneous video-assisted necrosectomy for infected pancreatic necrosis

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SUMMARY
Aims of the study — Percutaneous drainage of infected pancreatic necrosis is not always efficient and morbidity is high with open necrosectomy techniques. Minimally-invasive procedures have been developed to reduce this morbidity. We report our early experience with percutaneous video-assisted necrosectomy.

Methods — Among 61 patients with acute pancreatitis treated between January 2001 and February 2003, seven developed infected pancreatic necrosis. Six of these seven patients underwent percutaneous video-assisted necrosectomy after failure of radioguided percutaneous drainage.

Results — One to four sessions of percutaneous video-assisted necrosectomy were required. There was no death. Sepsis control was achieved in all patients. One patient developed postoperative peritonitis due to intraoperative contamination of the peritoneal cavity. Eighteen months after the last necrosectomy, one patient developed a pseudocyst which was successfully cured by percutaneous drainage. One patient developed diabetes mellitus.

Conclusion — Early experience in six patients has shown that percutaneous video-assisted necrosectomy is feasible, safe and efficient, in accordance with reports in the literature. Further evaluation is necessary.

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Pancreatic and peripancreatic necrosis and associated super-infection are serious events in the course of acute pancreatitis. Treatment of infected pancreatic necrosis is particularly difficult requiring necrosectomy and drainage, generally by an open procedure [1]. The risk of procedure-related morbidity is high for these complex mutilating interventions [2-5]. Less invasive procedures have been proposed to achieve limited retroperitoneal access [6, 7] and percutaneous drainage. Failure is not exceptional after percutaneous drainage, making further manipulations necessary; drains may have to be changed and total duration of treatment is long [8, 9]. Percutaneous video-assisted necrosectomy (PVAN) using the tract of a drain inserted under radiographic guidance is a relatively novel approach designed to achieve necrosectomy under visual control via the most direct approach possible. The purpose of this study was to report early results obtained with this technique.

Patients and method
Sixty-one patients were treated for acute pancreatitis between January 2001 and February 2003. Among these 61 patients, seven developed infected pancreatic necrosis. Radio-guided percutaneous drainage was curative in one patient but was unsuccessful in the six others who were then treated by PVAN. All six patients were men, mean age 46 years (range: 23-78). The underlying cause of pancreatitis was gallstones in one, alcoholic pancreatitis in four, and undetermined in two. The mean Ranson score [10] was 5 (range: 3-9). Abdominal computed tomography (CT) with contrast injection demonstrated severe necrosetting pancreatitis in all patients: Balthazar grade D (N = 2) and grade E (N = 4) [11]. Five patients required intensive care during the initial phase of pancreatitis; mean stay in the intensive care unit was 11 days (range 3-30). Episodes of hemodynamic instability lasting one or two days after onset of pancreatitis led to exploratory laparotomy in two patients to search for intestinal ischemia but only revealed acute pancreatitis. In one patient, corrugated drains were used for the peritoneal cavity and the omental bursa. In the other, a Mikulicz drain was inserted in a hemorrhagic omental bursa.

After the second week of hospitalization, necrosis progressed to suppuration in all six patients. In the patient who had a Mikulicz drain, a
purulent discharge via the drain tract occurred one week after withdrawing the drain. A 28F drain was inserted via the tract to reach the area of pancreatic necrosis. For the five other patients, infected necrosis was evoked by the CT-scan which demonstrated heterogeneous air-fluid collections. Percutaneous CT-guided drainage was performed because of the clinical signs of suppuration and confirmed the diagnosis. A 14F drain was positioned in the suppurating pancreatic zone using a percutaneous lumbar approach in these five patients. The 14F drain was replaced by a 24F drain a few days later to improve drainage. Suppuration persisted in all six patients despite daily irrigation. Clinical and biological signs of infection persisted. Results of the bacteriological specimens are presented in table I.

PVAN was performed. Patients were placed in the supine position under general anesthesia. The left flank was raised with a cushion to allow access to the orifice of the retroperitoneal drain. Leak-proof plastic-coated drapes were used to avoid loss of body heat via leakage of the irrigation fluid and the patient was covered with a heating pad. The drain tract was dilated progressively to 30F allowing insertion of a trocar. A rigid nephroscope (Storz, Tuttlingen, Germany) was introduced through the trocar to reach the infected zone of pancreatic necrosis. The nephroscope was connected to an irrigation-suction system and a video car. A rigid nephroscope (Storz, Tuttlingen, Germany) was introduced via the 5 mm operator canal of the nephroscope was used to achieve necrosectomy under visual control. To avoid bleeding, necrosectomy was limited to debriding easily removed necrotic tissue. At the end of the procedure a Van Kemmel drain (Porges, Le Plessis Robinson, France) was introduced into the necrotic cavity via the drainage orifice.

Oral food intake was allowed the evening of the procedure. The cavity was flushed out regularly and irrigated at night with two liters of saline via the Van Kemmel drain. Gravity drainage was continued during the day when ambulation was possible. Clinical signs and laboratory results were noted daily. An abdominal CT-scan was performed a few days after each session of necrosectomy then at one month, three and six months after discharge.

### Results

#### Intervention

Mean time from onset of acute pancreatitis to the diagnosis of infected pancreatic necrosis was 23 days. Mean time from onset of pancreatitis to the first session of PVAN was 48 days (range: 28-92). Mean time from radioguided drainage to the first PVAN was 25 days (range 13-46) (table I). Patients underwent one to four PVAN sessions. PVAN was performed via the retroperitoneal lumbar drain tract in five patients and via the residual anterior Mikulicz tract in one.

Mean operative time was 130 minutes. A flexible cholecyscope was used in addition to the nephroscope in one patient but the operating canal was too small for effective necrosectomy. An open procedure via a 3 cm incision in the left flank was performed during one PVAN session in one patient to evacuate a purulent left retrocolonic collection measuring 3 cm in diameter.

### Perioperative morbidity

There was no death. One patient developed postoperative peritonitis after the fourth PVAN session: the irrigation fluid injected under probably excessive pressure ruptured pseudomembranes limiting the suppurating area, leading to contamination of the peritoneal cavity. One patient developed 40 °C fever 24 hours after a third PVAN session; the episode resolved after parenteral infusion of a broad-spectrum antibiotic. One patient rapidly developed insulin-dependent diabetes.

None of the patients required intensive care after necrosectomy. No cases of intra- or post-operative bleeding occurred and no transfusions were required. There were no cases of gastrointestinal or pancreatic fistulization.

### Course of the suppuration

Suppuration subsided following a mean of 139 days (range: 85-325) counting from percutaneous drainage and in 114 days (range: 46-300) counting from the first PVAN session. All patients were given adapted parenteral antibiotics for a mean 30 days (range: 7-59) starting from the first PVAN session. For the patient who underwent one PVAN session via the Mikulicz tract, suppuration had resolved on day 80. Mean overall hospital stay was 75 days (range: 50-130). On average, patients were discharged

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Table I. – Summary of the six patients with infected pancreatic necrosis treated by percutaneous video-assisted necrosectomy (PVAN).

<table>
<thead>
<tr>
<th>Patient</th>
<th>Ranson Score</th>
<th>Balthazar Score</th>
<th>Isolated germs</th>
<th>Time from diagnosis to infection (days)</th>
<th>Time from 1st PVAN (days)</th>
<th>Number of PVAN sessions</th>
<th>Duration of antibiotic therapy after 1st PVAN (days)</th>
<th>Duration of suppuration after 1st PVAN (days)</th>
<th>Hospital stay (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5</td>
<td>E</td>
<td>Staphylococcus aureus Enterobacter cloacae</td>
<td>26</td>
<td>50</td>
<td>1</td>
<td>59</td>
<td>300</td>
<td>83</td>
</tr>
<tr>
<td>2</td>
<td>7</td>
<td>D</td>
<td>Escherichia Coli Pseudomonas Streptococcus B</td>
<td>46</td>
<td>92</td>
<td>2</td>
<td>29</td>
<td>83</td>
<td>130</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>D</td>
<td>Citrobacter freundii Escherichia Coli Pseudomonas Candida albicans</td>
<td>14</td>
<td>31</td>
<td>4</td>
<td>58</td>
<td>94</td>
<td>50</td>
</tr>
<tr>
<td>4</td>
<td>9</td>
<td>E</td>
<td>Enterobacter cloacae</td>
<td>28</td>
<td>43</td>
<td>2</td>
<td>25</td>
<td>80</td>
<td>62</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>E</td>
<td>Acinetobacter baumannii Stenotrophomonas maltophilia Hafnia Alves</td>
<td>15</td>
<td>28</td>
<td>3</td>
<td>7</td>
<td>85</td>
<td>60</td>
</tr>
<tr>
<td>6</td>
<td>3</td>
<td>E</td>
<td>Enterococcus faecium Citrobacter freundii Hafnia alvei Escherichia Coli</td>
<td>10</td>
<td>48</td>
<td>2</td>
<td>10</td>
<td>46</td>
<td>64</td>
</tr>
</tbody>
</table>
26 days after the first PVAN session (range: 16-38). Two of the six patients returned directly to their home.

Late morbidity

The mean follow-up in this cohort was seven months (range 2-20). One patient developed a symptomatic pseudocyst 18 months after his last necrosectomy. The 10 cm pseudocyst located in the omental bursa was successfully treated with percutaneous draining and somatostatin analogs.

Discussion

Our early experience illustrates the feasibility of PVAN. Results have been good with no mortality and limited morbidity. Patient benefit has been significant. The one peritoneal accident probably caused by rupture of the suppuration sac highlights the importance of well-controlled low irrigation pressure. It should be noted that intraoperative irrigation is not always indispensable; the pancreatic cavity did not have to be filled with saline so we could work in an air atmosphere allowing better vision. We only irrigated as needed to remove pus, sequestered tissue or blood from the working area.

Enteral fistulization did not complicate the percutaneous procedure. The precise position of the drain inserted under CT guidance avoided the risk of damaging neighboring tissues. Using a rigid nephroscope to achieve necrosectomy appears to be very effective when the retroperitoneal drain tract runs straight into the pancreatic cavity. The anterior approach via the Mikulicz tract, used in only one patient, did not allow much space for the rigid nephroscope. Carter et al. used a flexible 45F fibroscope for certain situations [7]. We have not had any experience with this larger type of instrument but found that the flexible choledochoscope is not adapted due to the narrow operating canal. The nephroscope accepts 5 mm laparoscopy forceps. It is important to insert a two-way drain at the end of the PVAN session to enable flushing and irrigation. Necrosectomy sessions must be repeated because a large proportion of the necrotic tissue adheres strongly at the first session and cannot be removed without triggering hemorrhage [7]. The next session can be scheduled three to six days later.

None of our patients required intensive care after PVAN but none of them presented organ failure before the procedure.

The period of drainage was long: 139 days counting from insertion of the percutaneous drains. With experience, the length of this period declined from 325 to 85 days. It should be noted however that we measured this period as the time when the drain was left in place. This time was prolonged by prudence beyond discharge since local care was simple. The overall hospital stay was 75 days and patients were discharged on the average 26 days after PVAN. PVAN was undertaken following failed percutaneous drainage, and was initiated on average 25 days (range: 13-46) after insertion of the percutaneous drain. This interval could be reduced to only five or six days, the time generally necessary for adequate installation of a large-diameter drain.

The only late complication observed in our patients was one pseudocyst which developed in the omental bursa 18 months after the last PVAN session. The lumbar approach spared the abdominal wall, thus avoiding the risk of incisional hernia.

Carter et al. [7] reported the first experience with PVAN. They performed first-intention PVAN in ten patients using a de novo retroperitoneal tract and second-intention PVAN in four patients who had drains inserted during prior laparotomy [7]. These authors reported three deaths attributed to precarious general status, and one other attributed to bleeding subsequent to splenic vein injury. As was the case for our six patients, none of their patients developed an enteral fistula. These authors conclude that PVAN is as effective as laparotomy. They nevertheless emphasize the need for repeated sessions associated with post-operative drainage to achieve complete cure and are prudent during the first session to avoid injuring vessels during the early stages of the disease. For this group, the lack of the opportunity to explore the abdominal cavity and search for possible associated colonic necrosis is a drawback of the technique. Fenton-Lee et al. also observed that patients require intensive care less often after PVAN and that in addition to substantial economic savings, the technique is particularly useful for elderly patients [12].

This necrosectomy technique should be compared with more classical techniques of resection. With the open approach, a large volume of necrotic tissue can be removed and the abdominal cavity can be explored, but the post-operative period is often difficult. Re-operations are often needed and surgical drains require careful management [2-5]. Mikulicz drainage, which we prefer when laparotomy is indispensable, induces enteral fistula and persistent suppurations. Laparoscopic necrosectomy via a transgastric approach or through the gastrocolonic ligament has been described, but results are not often reported [13-15]. The high risk of peritoneal cavity contamination is a major drawback to this technique.

The transperitoneal approach can be compared with the retroperitoneal approach. When performed via lumbotomy, the procedure is difficult and raises the risk of injury to the spleen and the left colon [16]. Retroperitoneoscopy, developed in France by Sarrazin [17] is a less aggressive variant [5, 18]. Gambiez et al. treated 20 patients with this method and reported two deaths, one colonic fistula and one hemorrhage as well as two secondary laparotomies [6]. Horvath et al. treated six patients using retroperitoneoscopy with air insufflation. They reported one enteral fistula and several revision procedures [19]. The retroperitoneal approach is probably dangerous if a direct tract is fashioned during one session instead of “preparing” tract by prior radioguided percutaneous drainage.

Exclusive percutaneous drainage is the least invasive option available. It is particularly effective for abscess drainage but not for infected necrosis where large pieces of necrotic tissue may have to be debrided [8, 9]. Gouzi et al. emphasized the need for large-diameter drains for this purpose and also noted that drains have to be changed [9]. The benefits of this technique are attenuated by the high risk of failure and enteral fistulae; conversion to open surgery is often required [8, 9]. Chenevi et al. proposed using suction for percutaneous necrosectomy. These authors used basket probes with large-caliber perforated drains inserted under radiographic guidance during several long sessions (mean 17 sessions) [20]. The need for regular irrigation, the frequent inefficacy, the requirement for many manipulations to change the drains, and also the risk of fistulization, which is not avoided, are the main problems with percutaneous drainage.

In our experience, even when large-caliber percutaneous drains can be inserted, attempting to wash-out the cavity with repeated irrigation-suction is not very effective for authentic infected pancreatic necrosis, as opposed to an abscess which is a collection of liquid pus [9, 12]. Necrotic pancreatic tissue has a mechanically resistant texture requiring digital or mechanical section. For us, this resistance warrants combining the advan-

ABBREVIATIONS:

PVAN : percutaneous video-assisted necrosectomy
CT : computed tomography

tages of retroperitoneal drainage with those of mechanical video-assisted necrosectomy. The retroperitoneal tract can be controlled on the CT-scan and its drainage-irrigation can be continued for several days (the time needed to obtain a sufficiently large caliber and, if the collection is a simple abscess, to achieve complete drainage); in case of failure and/or presence of necrotic debris in the drainage output, PVAN can be undertaken.

Despite the lack of proof from a prospective randomized trial, which is unlikely to be forthcoming, and although follow-up is too short for most of our patients to properly estimate post-operative morbidity, our early results appear to be superior to those obtained with other techniques used for the treatment of infected pancreatic necrosis.

In conclusion, PVAN appears to be an effective technique for active treatment of infected necrotic pancreatitis. PVAN can be proposed when radioguided percutaneous drainage is ineffective or as a first intention treatment in the event of proven “solid” necrotic material. This technique has allowed much more efficacious necrosectomy compared with percutaneous radioguided drainage and can be expected to limit the duration of external drainage without the risk of conventional open surgical necrosectomy. Our experience is in agreement with other reports in the literature but a large-scale study is needed for confirmation. Our results illustrate the principle of minimally-invasive surgery, allowing total resection of infected necrotic tissue via the least aggressive and least mutilating approach possible.

REFERENCES