



Algorithm-based care for early recognition and management of complications after pancreatic resection: toward standardization of postoperative care

Charles de Ponthaud^{1,2}, Sébastien Gaujoux^{1,2}

¹Department of Hepato-Biliary and Pancreatic Surgery and Liver Transplantation, AP-HP, Pitié-Salpêtrière Hospital, Paris, France; ²Sorbonne University, Paris, France

Correspondence to: Pr Sébastien Gaujoux, MD, PhD. Department of Digestive and Endocrine Surgery, Pitié-Salpêtrière Hospital, AP-HP, Sorbonne University, Bat. Husson Mourier, 47-83 Avenue de l'Hôpital, 75013 Paris, France. Email: sebastien.gaujoux@aphp.fr.

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This stepped-wedge cluster randomized study (1) included all pancreatectomies performed from 17 Dutch pancreatic surgery centers (all realizing >20 pancreaticoduodenectomies per year) over 22 months. The aim was to demonstrate the value of an algorithm for the early diagnosis and management of postoperative complications. This algorithm determined when to do abdominal computed tomography (CT) scan, radiological drainage, start antibiotic treatment, and remove abdominal drains. It was calculated every day from postoperative day 3 to 14. The primary endpoint was a composite of bleeding that required invasive intervention, organ failure and 90-day mortality.

A total of 1,748 patients were included: 885 in the control group and 863 in the interventional group. With a mean age of 65 years, the cohort included: 30% of American Society of Anesthesiologists (ASA) 3–4 patients, 75% of pancreaticoduodenectomies, 28% of minimally invasive surgery, 37% of adenocarcinoma, 10% of cholangiocarcinoma, 9% of intraductal papillary mucinous neoplasms (IPMN), 8% of neuroendocrine tumors (NET) and 5% of chronic pancreatitis.

This study shows a significant benefit in bleeding, organ failure and mortality from 14% (control group) to 8% (interventional group) ($P < 0.0001$). The same results were observed for each of the 3 variables taken independently: bleeding (6% *vs.* 5%; $P = 0.046$), organ failure (10% *vs.* 5%;

$P < 0.0001$) and 90-day mortality (5% *vs.* 3%; $P = 0.029$). The algorithm led to more frequent and earlier care and investigations (CT scan, antibiotic therapy and radiological drainage) than in usual practice, but without significant additional costs of management. There was also a benefit in terms of reintervention rate (8% *vs.* 5%; $P = 0.017$) and admission to intensive care unit (9% *vs.* 7%; $P = 0.0001$). However, there was no significant difference between the two groups concerning the rate of pancreatic fistula (21% *vs.* 28%; $P = 0.084$), delay before drain removal, median length of hospital stay (10 *vs.* 11 days; $P = 0.52$) and readmission rate (21% *vs.* 20%; $P = 0.70$).

This study is remarkable, even exceptional, both in terms of its methodology and its clinical relevance being a true game changer in our practice. There is an important literature aimed to reduce perioperative morbidity by means of various technical (2,3) or pharmacological (4,5) strategies as well as through pre/rehabilitation protocols (6,7), but the results are limited and not always convincing. The originality of this work lies not in the desire to prevent complications, but rather to optimize its early diagnosis and standardize its management in order to avoid failure to rescue (8).

The proposed algorithm is reliable. It has been designed in a collaborative discussion and validated by retrospective studies. It is based on usual clinical, biological and

radiological data, making it pragmatic. Its use is facilitated by a free application that can be downloaded on every smartphone from Apple Store (<https://apps.apple.com/nz/app/pancreatic-surgery/id1607487269>) or Google Play Store (<https://play.google.com/store/apps/details?id=com.everywhereim.dpcg&gl=NL>).

Adherence to the recommendations formulated by the algorithm was between 70% and 83%, which is relatively high. Nevertheless, it would have been interesting to know the reasons for non-adherence to the proposals in the remaining cases. It is undeniable that clinical judgement still plays an important role in certain situations, probably not taken into account by the algorithm.

The clinical impact of this study on our practices is considerable, as we note a reduction of almost 50% in postoperative mortality after application of the algorithm. Interestingly, this result is present in both high-volume centers (defined as >45 pancreatic resections/year in the study) and medium-low volume centers, and regardless of the surgical approach (minimally invasive *vs.* open surgery). It should be noted, however, that these results were only significant in patients undergoing pancreaticoduodenectomies. This may be partly explained by the lower statistical power, due to the lower proportion of other types of pancreatectomies in the included population (<25%).

The algorithm of this study also proposes a standardization of the drain removal allowing their ablation as early as possible. Indeed, despite the existence of several studies suggesting the benefits of such a strategy (9), the management of drains (removal, mobilization, loss of vacuum, etc.) remains esoteric and is more a matter of individual preference or experience. It should also be noted that there was no difference in the delay before drain removal between the two groups, on average at postoperative day 5.

Finally, this algorithm imposes a reinforced surveillance. A postoperative CT scan was performed more frequently (65% *vs.* 53%, $P=0.031$) and earlier (-2 days; $P<0.0001$) in the interventional group and led to a percutaneous drainage and antibiotic therapy more rapidly (1 day) and more frequently (but not significantly). It should be noted that in the proposed algorithm, antibiotic therapy was systematically administered for any pancreatic fistula associated with an inflammatory syndrome, regardless of whether or not an infection was documented. On the other hand, it highlights the interest of early percutaneous drainage, whose benefit in terms of survival compared to

reintervention has been demonstrated in the management of pancreatic fistula after pancreaticoduodenectomy (10).

This reinforced (or “pro-active”) surveillance is part of a desire to “re-medicalize” postoperative care. Far from replacing the importance of clinical judgement, it demonstrates that surgical intuition is not always sufficient for optimal patient management, and that the organization of a standardized care pathway has become necessary. In order to do this, it requires the presence of a complete and available technical platform and may come up against frequent logistical difficulties (access to the CT scan, availability of interventional radiology staff, etc.). Smits et al implicitly reaffirms the importance of centralizing pancreatic surgery in high-volume expert centers equipped with these material and human resources. Finally, this study demonstrates that postoperative management is at least as essential as a well performed surgery and a properly conditioned patient. It cannot be delegated to non-specialized or poorly trained practitioners. Post-operative care management must remain the surgeons’ business!

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Footnote

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