CIRUGÍA ESPAÑOLA

www.elsevier.es/cirugia

Original article

Surgical treatment of pancreatic adenocarcinoma by cephalic duodenopancreatectomy (Part 1). Post-surgical complications in 204 cases in a reference hospital

Juli Busquets,[a,] Juan Fabregat,[a] Rosa Jorba,[a] Núria Peláez,[a] Francisco García-Borobia,[a] Cristina Masuet,[b] Carlos Valls,[c] Laura Martínez-Carnicero,[c] Laura Lladó,[a] and Jaume Torrasa*

[a]*Servicio de Cirugía General y Digestiva, Hospital Universitari de Bellvitge, L'Hospitalet de Llobregat, Barcelona, Spain*
[b]*Servicio de Medicina Preventiva, Hospital Universitari de Bellvitge, L'Hospitalet de Llobregat, Barcelona, Spain*
[c]*Servicio Radiodiagnóstico, Hospital Universitari de Bellvitge, L'Hospitalet de Llobregat, Barcelona, Spain*

ARTICLE INFORMATION

Article history:
Received March 5, 2010
Accepted May 9, 2010

Keywords:
Carcinoma of the pancreas
Pancreatic resection surgery

ABSTRACT

Introduction: Cephalic duodenopancreatectomy (CDP) is the treatment of choice in cancer of the head of the pancreas. However, it continues to have a high post-surgical morbidity and mortality.

The aim of this article is to define variables that influence post-surgical morbidity and mortality after cephalic duodenopancreatectomy due to pancreatic adenocarcinoma (PA) cancer of the head of the pancreas (CHP).

Material and methods: The variables were prospectively collected form patients operated on between 1991 and 2007, in order to investigate the factors of higher morbidity.

Results: A total of 204 patients had been intervened due to PA, of whom 57 were older than 70 years. Of these patients, 119 had a CDP, 11 extended lymphadectomy, 66 with pyloric conservation, and 8 with extension to total pancreatectomy due to involvement of the section margin. Portal or mesenteric vein resection was included in 35 cases. Post-surgical complications were detected in 45% of cases, the most frequent being: slow gastric emptying (20%), surgical wound infection (17%), pancreatic fistula (10%), and serious medical complications (8%). Further surgery was required in 13%, and the over post-surgical mortality was 7%. A patient age greater than 70 years, post-surgical haemoperitoneum, gastroenteric dehiscence, and the presence of medical complications were post-surgical mortality risk factors in the multivariate analysis. Pancreatic fistula was not a factor associated with post-surgical mortality.

Conclusions: Cephalic duodenopancreatectomy is a safe technique but with a considerable morbidity. Patients over 70 years of age must be carefully selected before considering surgery. Serious medical complications must be treated aggressively to avoid an unfavourable progression.

© 2010 AEC. Published by Elsevier España, S.L. All rights reserved.

*Corresponding author.
E-mail address: jbusquets@bellvitgehospital.cat (J. Busquets).

0009-739X/$ - see front matter © 2010 AEC. Published by Elsevier España, S.L. All rights reserved.

Tratamiento quirúrgico del adenocarcinoma pancreático mediante duodenopancreatectomía cefálica (Parte 1). Complicaciones postoperatorias en 204 casos en un centro de referencia

Palabras clave:
Adenocarcinoma páncreas
Cirugía resectiva páncreas

R E S U M E N

Introducción: La duodenopancreatectomía cefálica (DPC) es el tratamiento de elección en el adenocarcinoma de cabeza de páncreas. Sin embargo, sigue presentando elevada morbilidad y mortalidad posquirúrgica.

El objetivo de este estudio es definir las variables que influyen en la morbilidad y mortalidad postoperatoria tras la duodenopancreatectomía cefálica por adenocarcinoma de páncreas (ADCP).

Material y métodos: Se han recogido prospectivamente las variables de los pacientes intervenidos entre 1991-2007, con el fin de investigar los factores asociados a una mayor morbilidad.

Resultados: Se han intervenido 204 pacientes por ADCP, de ellos 57 eran mayores de 70 años. Se han realizado 119 DPC, 11 con linfadenectomía extendida, 66 DPC con preservación pilórica y 8 con ampliación a pancreatectomía total por afectación del margen de sección. Treinta y cinco casos asociaron resección venosa portal o mesentérica. Se han detectado complicaciones postquirúrgicas en el 45% de casos, las más frecuentes: vaciado gástrico lento (20%), infección incisional (17%), fístula pancreática (10%), y complicaciones médicas graves (8%). El 13% fue reintervenido y la mortalidad postoperatoria global fue del 7%. La edad del paciente superior a 70 años, el hemoperitoneo postoperatorio, la dehiscencia gastroentérica, y la presencia de complicaciones médicas graves fueron factores de riesgo de mortalidad postquirúrgica en el estudio multivariante. La fístula pancreática no fue un factor relacionado con la mortalidad posquirúrgica.

Conclusiones: La duodenopancreatectomía cefálica es una técnica segura pero con morbilidad considerable. Los pacientes con edad superior a 70 años deben ser seleccionados cuidadosamente antes de intervenirlos. Las complicaciones médicas graves deben tratarse de forma agresiva para evitar una evolución desfavorable.

© 2010 AEC. Publicado por Elsevier España, S.L. Todos los derechos reservados.

Introduction

Surgery is the only treatment with a real impact on survival of patients with resectable pancreatic adenocarcinoma, and the most widely accepted technique for treating this type of tumour is cephalic duodenopancreatectomy (CDP). In spite of advances in technique and perioperative patient care, complications appear in 40%-60% of patients following a CDP.[1-4] The objective of this study is to review the results obtained in our hospital in the surgical treatment of cancer of the head of the pancreas and to define the variables that influence postoperative mortality and morbidity.

Material and methods

We have compiled in this article the experience of treating adenocarcinomas of the head of the pancreas (ADHP) in the University Hospital of Bellvitge by cephalic duodenopancreatectomy (CDP) between 1991 and 2007. We pospectively recorded the clinical and surgical data on all patients.

Preoperative patient management

All patients that were admitted to our centre with obstructive jaundice were studied by the General Surgery Department in order to accelerate the period from diagnosis towards a procedure. The examination started with an abdominal ultrasound, followed by a helical computerised tomography (CT) performed by the Abdominal Radiology Department.[5] Given the timeline of the study, the CT technique was modified partway through. Between 1991 and 1994, a non-helical CT scan was used. Between 1994 and 2004, a single-cut helical CT scan was used. Since 2003, multidetector 4, 16, then 64 cut scans have been used. Preoperative biliary drainage has not been carried out systematically in all patients,[6] and was only indicated in patients where there were doubts on their final patient care or the surgery was expected to be delayed for over 15 days. Neither advanced age of the patient nor the size of the tumour have been considered contraindications of the procedure.

The criteria for non-resectability have been the presence of: metastasis, arterial invasion (superior mesenteric artery, hepatic artery, or celiac trunk), venous obliteration, or invasion of other adjacent organs (except the duodenum).[7] We have defined arterial invasion as the presence of direct contact between the tumour and the arterial vessel, even when below 50%. Regarding venous involvement, invasion is considered to be contact greater than 50% between the tumour and the vessel. Obliterations of any segment of the portal-mesenteric venous axis were considered unresectable.[8,9] All other venous parietal involvement were considered for resection.

Surgical technique

The surgical procedure started with a thorough and systematic examination of the abdominal cavity.[10] When there were signs that the disease had spread, a preoperative biopsy was performed. Resection was contraindicated if the biopsy was positive and a biliodigestive bypass was performed.[11,12] All patients were resected with curative intent, in other words, the macroscopic disease was removed during the procedure. The technique used was CDP, with a standard lymphadenectomy (peripancreatic and periduodenal lymph tissue) that was extended to the hepatic hilum, the right border of the superior mesenteric artery, and the pre-caval-aortic region.[13,14] In order to simplify the study of the affected regions of lymph nodes, we defined the peripancreatic region as the local territory, and the inter-caval-aortic region as the regional territory.[15,16] In the case of duodenal infiltration or ischaemic changes in the duodenum,[17-20] we opted for a hemigastrectomy (CDPW), and otherwise, we performed a pyloric preservation (CDPPP) (Figure). The reconstruction was performed in all cases with an anastomosis created between a single intestinal loop and the pancreas, bile duct, and duodenum, consecutively. The pancreaticojejunal anastomosis was preferentially performed terminal-lateral duct-mucosa, or terminal-terminal when the duct was too thin. Lastly, we placed aspiration drains close to the pancreaticojejunal anastomosis and one in the biliodigestive anastomosis.

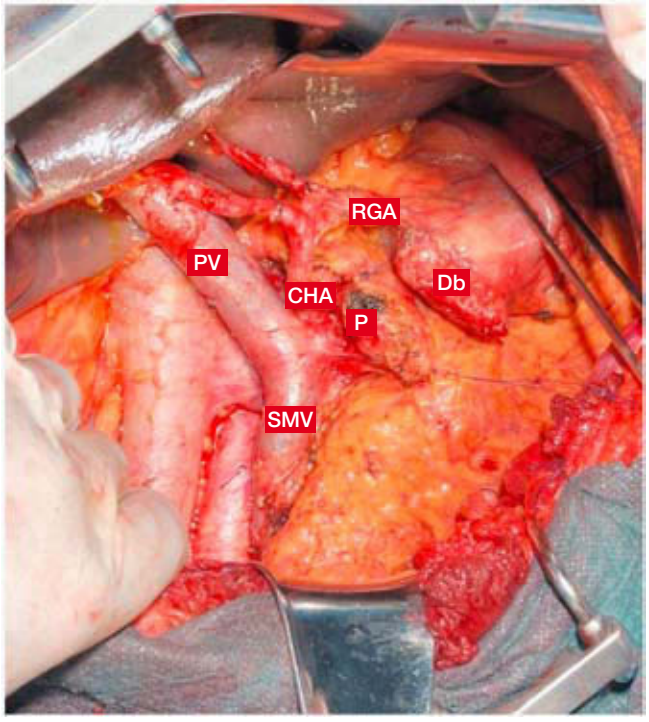

Figure 1 – Close up of a duodenopancreatectomy with pyloric preservation. CHA indicates common hepatic artery; Dd, duodenum; P, neck of the pancreas; PV, portal vein; RGA, right gastric artery; SMV, superior mesenteric vein.

Definitions

The pancreatic duct was considered thin when it was less than 3 mm in diameter, and thick when equal to or greater than 3 mm.[21] Delayed gastric emptying (DGE) was defined in the patients that required a nasogastric tube longer than 10 days after the operation.[16] A pancreatic fistula[16,22] was diagnosed when the liquid exiting the drains was rich in amylase after the 3rd day following the operation, using the classification developed by the international study group on pancreatic fistula (ISGPF[22]). Postoperative morbidity was considered to be any complication that arose during the patient hospitalisation period, and postoperative mortality was deaths that occurred during this period.[23,24] We recorded the presence of the following complications: delayed gastric emptying, haemoperitoneum, upper gastrointestinal bleeding, pancreatic fistula, biliary fistula, gastroenteroanastomosis dehiscence, incisional infection, respiratory infection, urinary infection, catheter infection, intraabdominal abscess, peritonitis, and acute pancreatitis. Other postoperative complications that did not fall within these categories were counted as severe medical complications for better statistical analysis. We registered complications such as complications to the central nervous system, pulmonary thromboembolism, respiratory distress, or acute myocardial infarction, among others, in accordance with the concepts defined by the ISGPF.[22]

Statistical analysis

We performed a descriptive statistical analysis based on measures of central tendency (mean, median) and variation (standard deviation and interquartile range) according to the criteria for normality (Kolmogorov-Smirnov test). We then performed a comparative study between qualitative variables using Chi-squared and Fisher tests, and quantitative variables using the Student's t-test or Mann-Whitney U test. Those variables that had a *P* value less than 0.10 with no interaction between them were considered in a binary logistical regression model, with the dependent variable set as postoperative mortality or morbidity. We used SPSS software version 12.0®, and *P* values <.05 were considered to be statistically significant in all cases.

Results

Demographical data

Our centre performed 204 CDP for ADHP during the period from 1991 to 2007. All patients were operated on in our hospital by the same team of surgeons, in accordance with the surgical technique decided upon by the head surgeon (J. Fabregat). Regarding the demographical data, 57 patients (28%) were older that 70 years old, and the majority were male (62%). The preoperative examination revealed that 62 patients (31%) had some type of severe, but not incapacitating, systemic disease pathology (category A.S.A. III[25]). Regarding preoperative care, 43 patients (21%) received a biliary drain (Table 1). The mean

postoperative hospitalisation period was 19 (12) days, with a range of 6 to 96 days.

Surgical technique and anatomopathological study

The most frequently used surgical technique was resection of the head of the pancreas with gastrectomy, used in 58% of cases, and pyloric preservation was used in 66 cases (33%). Thirty-five patients (17%) underwent a resection of the portal vein or superior mesenteric vein, and a total pancreatectomy had to be carried out in 8 cases (4%) as the edges had been affected (Table 1). Resection of the portal vein or superior mesenteric vein took place through a lateral plasty in 16 cases, venous resection and termino-terminal anastomosis in 16, and placing a graft (autologous or from a cadaver) in 3 cases. One young patient underwent a resection of the hepatic and gastroduodenal arterial confluence, as well as the portal vein with placement of both grafts from a cadaver. At the beginning of the study, an extended lymphadenectomy (CDPWR2, adenopathy resection in the territories of the celiac trunk and the left side of the Superior Mesenteric Artery) was performed on 11 patients (5%), a technique that was later abandoned due to the high rate of morbidity.

Postoperative complications

A total of 91 patients (45%) had some type of postoperative complication, DGE being the most frequent which affected 20% of patients. A pancreatic fistula was identified in 21 cases (10%), 5 of which were type B and 12 that were type C (patient with associated reoperation or postoperative death) according to the ISGPF classification system.[22] Biliary fistula were found in 10 cases (5%) and gastroenteric fistula in 9 (4%). Haemorrhagic complications appeared in 13 cases in the form of haemoperitoneum, and in 11 cases as upper gastrointestinal haemorrhage. The most frequently registered septic complication was incisional infections (32, 17%) (Table 1). The mean postoperative duration of hospitalisation was greater in patients with postoperative complications: 26 vs 13 days ($P<.001$).

Twenty-six patients required reoperations (13%). The indication for the reoperation in 5 patients was haemoperitoneum, intraabdominal abscesses in 4 cases, upper gastrointestinal bleeding in 2 cases, choleperitoneum in 2 cases, dehiscence of the gastroenteric sutures in 2 cases, and evisceration in 2 cases. Lastly, 9 patients were reoperated for pancreatic fistula, 6 underwent a total pancreatectomy, and 3 underwent drainage of the pancreatic fistula. Among the patients that underwent reoperations, 8 died.

Table 1 – Characteristics of the patients operated on for adenocarcinoma of the head of the pancreas. Hospital Universitari de Bellvitge. 1991-2007

Variables	No.	%	No.	%
Sex (male/female)	127	62	77	38
Age (<70/>70 years)	147	72	57	28
A.S.A. (I-II/III)	138	69	62	31
ERCP (yes/no)	43	21	158	79
Surgical technique (CDPW-CDPWR2-PT)	119 66	58 33	11 8	5 4
Venous resection (yes/no)	35	17	169	83
Wirsung duct (thin/thick)	86	55	69	45
Pancreas (soft/hard)	60	39	95	61
Stent (yes/no)	27	17	135	83
PJ anastomosis (DM – non DM)	108	57	81	43
Duration of the procedure (min) (<360/>360)	76	42	104	58
Presence of complications (yes/no)	91	45	112	55
Surgical reoperation	26	13	177	87
Postoperative mortality (yes/no)	14	7	190	93
Delayed gastric emptying (yes/no)	39	20	151	80
Haemoperitoneum (yes/no)	13	6	188	94
Upper gastrointestinal haemorrhage (yes/no)	11	5	186	95
Pancreatic fistula (yes/no)	21	10	180	90
Biliary fistula (yes/no)	10	5	191	95
Gastroenteric dehiscence (yes/no)	9	4	192	96
Incisional infection (yes/no)	32	17	161	83
Respiratory infection (yes/no)	7	4	186	96
Urinary infection (yes/no)	9	4	181	96
Catheter infection (yes/no)	10	5	179	95
Acute peritonitis (yes/no)	7	3	192	97
Acute pancreatitis (yes/no)	3	2	189	98
Intraabdominal abscess (yes/no)	15	7	185	93
Severe medical complications (yes/no)	15	8	175	92
Transfusion during first 48 h (yes/no)	141	72	53	28

CDPW indicates hemigastrectomy.

Severe medical complications appeared in 15 patients (8%). We registered a variety of pathologies, among them: 4 patients with heart failure, 2 with acute respiratory failure, 1 evisceration, 1 intestinal obstruction, 1 acute kidney failure, 1 intestinal ischaemia, 1 tracheal perforation, 1 stroke, 1 necrosis of the abdominal wall, 1 ischaemic colitis, and 1 severe cardiac arrhythmia. Five of these patients died, due to heart failure (2), septic shock (2), and massive intestinal ischaemia (1).

We identified advanced age (greater than 70 years, P=.02) and the underlying pathology (A.S.A. III, P=.04) as risk factors in the univariate analysis of risk factors following surgery. Among the intraoperative details, pancreatic sutures on a thin duct (P=.007), a soft pancreatic gland (P=.002), and a non-ductal-mucosal suture (P=.05) were factors that resulted in greater complications. In the multivariate study, we observed that only a hard consistency of the pancreas was a protective factor for the development of postoperative complications (OR=0.4 (0.1-0.8)). The rest of the risk variables lost statistical significance.

Postoperative mortality

Postoperative mortality was 7% (14/204). In the univariate analysis, we found that age greater than 70 years (P=.001), underlying pathology (A.S.A. III, P=.003), and the presence of severe medical complications (P<.001) during the postoperative period were risk factors for mortality following the operation. When performing the multivariate analysis, we confirmed that advanced age, the presence of postoperative complications, and severe surgical complications such as haemoperitoneum and dehiscence of the gastroenteroanastomosis continued to be risk factors for mortality during the immediate postoperative period (Table 2).

Discussion

In Argentina, few centres have previously published their experience in treating this pathology, and the only studies have referred to different types of tumours in the periampullary area, or with a small number of patients.[26-29] Our study is the most extensive national work published until now regarding the results of surgical treatment of ADHP. This study attempts to clarify which factors may influence the appearance of postoperative complications.

Pancreatic resection in patients >70 years

As we have demonstrated, advanced age is a determining factor in patient evolution. Indeed, 15% of our patients older than 70 years died following surgery, as opposed to 4% in those younger than 70. Controversy exists in the literature regarding the indications for pancreatic surgery in elderly patients. Whereas some groups defend their results of this procedure in patients of an advanced age,[4,30] others point out the risks inherent to patients older than 70 years.[31] A great many different factors could explain these differences, but this still remains to be clarified. Tani[4,30] only demonstrated a greater percentage of DGE in these patients, although elderly patients had different characteristics before the operation, such as a higher A.S.A. classification and reduced haemoglobin and albumin levels. In another study with groups with the same A.S.A. status, diagnosis, sex, and body mass index, Ouaissi[31] demonstrated that patients older than 70 years had higher rates of postoperative mortality (4 vs 0) and postoperative morbidity (56% vs 36%), although without statistical significance. Lastly, Boldt[32] recently demonstrated in a randomised study that elderly patients were more sensitive to the administration of crystalloids during surgery, since this creates greater endothelial damage and increases inflammation markers. As it is shown, intraoperative care and postoperative reanimation in this type of patient should probably be reviewed in order to reduce postoperative morbidity. In spite of our findings, surgery is only contraindicated in elderly patients with associated comorbidity in our institute.

Gastroenteric anastomosis

The most frequently observed complication in our study was delayed gastric emptying. We do not systematically use octeotide or erythromycin at our hospital, since insufficient evidence exists in randomised studies,[33-35] or in meta-analyses[36] to support their use, and it has even been noted that their use can aggravate the patient's condition.[37] Multiple factors have been demonstrated to cause DGE. The appearance of DGE was attributed by some to surgery with pyloric preservation (CDPPP).[38] However, later well-designed studies did not confirm this theory.[17,39] Recently, a randomised study demonstrated that, following CDPPP, reconstruction of the gastroenteric suture in an antecolic position is a determining factor for reducing delayed gastric emptying.[40] We have used this technique in our hospital since 2007, and the use of this procedure (data not shown) has led to reduced incidence of DGE.

Lastly, we have shown that dehiscence of the gastroenteric suture is one of the variables associated with increased postoperative mortality in the multivariate analysis. Several different factors such as urea and creatinine levels before the operation and intraoperative haemorrhage have been associated with gastroenteric fistula.[41] This indicates that, in addition to the surgical technique, the perioperative management of the patient plays an integral role in reducing this complication.

Pancreatic fistula following a cephalic duodenopancreatectomy

The incidence of pancreatic fistula in our hospital is similar to rates presented in other studies,[21,22,42] with a higher percentage of appearance if the gland is of a soft consistency. One of the surprising results from our study was the evidence that the most feared complication in pancreatic surgery is not a factor that affects mortality. Medical and percutaneous patient care have evolved in recent years, with the appearance of new materials for surgical drainage, interventional radiology, and improved methods of administering parenteral nutrition. Indeed, a reduced duration of hospitalisation and mortality

Table 2 – Risk factors for postoperative mortality following cephalic duodenopancreatectomy for adenocarcinoma of the head of the pancreas

Variables	Postoperative mortality			
	Univariate analysis			Multivariate analysis
	No.	%	P	P; OR (95% CI)
Sex				
Male	9	7	ns	ns
Female	5	6		
Age				
<70 years	6	4	**.001**	**.007; 18 (2.2-152)**
>70 years	8	15		
A.S.A.				
I-II	6	4	**.003**	ns
III	8	13		
ERCP				
Yes	4	9	ns	
No	9	6		
Surgical technique				
CDPW	9	7	ns	
CDPWR2	1	9		
CDPPP	3	4		
PT	1	12		
Venous resection				
Yes	–	–	ns	
No	14	8		
Wirsung duct				
Thin	7	8	ns	
Thick	2	3		
Pancreas				
Soft	5	8	ns	
Hard	4	4		
Pancreatic anastomosis				
DM	4	4	ns	ns
Non-DM	8	10		
Duration of the procedure				
<360 min	3	4	ns	
>360 min	6	6		
Delayed gastric emptying				
Yes	2	5	ns	
No	6	4		
Haemoperitoneum				
Yes	7	54	**<.001**	**.001; 27 (3.6-203)**
No	7	4		
Upper gastrointestinal haemorrhage				
Yes	3	27	**.02**	
No	10	5		
Pancreatic fistula				
Yes	5	24	**.008**	ns
No	9	5		
Biliary fistula				
Yes	2	20	ns	
No	12	6		
Gastroenteric dehiscence				
Yes	5	55	**<.001**	.001; 71 (5.7-898)
No	9	5		

Tabla 2 *(continued)*

Variables	Postoperative mortality			
	Univariate analysis			Multivariate analysis
	No.	%	P	P; OR (95% CI)
Incisional infection				
Yes	2	6	ns	
No	11	7		
Respiratory infection				
Yes	2	28	ns	
No	11	6		
Urinary infection				
Yes	–	–	ns	
No	13	7		
Catheter infection				
Yes	2	20	ns	
No	11	6		
Acute peritonitis				
Yes	3	43	**.007**	
No	10	5		
Acute pancreatitis				
Yes	1	33	ns	
No	12	6		
Intraabdominal abscess				
Yes	1	7	ns	
No	12	6		
Medical complications				
Yes	5	33	<.001	.003; 13 (2.3-71)
No	8	5		

CDPPP indicates pyloric preservation; CDPW, hemigastrectomy; CI, confidence interval; OR, odds ratio.

was demonstrated in 129 patients treated in interventional radiology centres, all of which followed a CDP.[43] In our patients, we performed lavages in the intraabdominal drains following the appearance of a pancreatic fistula in order to avoid the persistence of local sepsis. With this methodology, reoperations were indicated in 9 patients with pancreatic fistula, whereas this was avoided in 12 cases. Lastly, 5 of these patients died (24%). Similarly, other publications have demonstrated that the type of intraabdominal drain is also important in the management of pancreatic sutures.[44]

Medical complications following cephalic duodenopancreatectomy

Among the 15 patients that had some type of severe medical complication, 5 died. Medical complications tend not to be a focal point of research in published studies, but in our analysis, we have demonstrated a 30% mortality rate in the presence of medical complications, basically cardiorespiratory and vascular in nature. In 2 previous studies published by Johns Hopkins Hospital and the University of Zurich,[3,45] the importance of cardiopathies in pancreatic surgery was established. In the first published study,[45] the risk of pancreatic fistula was evaluated after 1891 cases of CDP. Coronary disease and soft consistency of the pancreas were the only two significant variables from the multivariate study that increased the risk of pancreatic fistula. The later study,[3] which analysed postoperative complications following 633 CDP, demonstrated that the cardiovascular pathology and the consistency of the pancreas were significant factors in the multivariate analysis. According to our experience, cardiovascular pathology is the main medical complication to be considered after surgery. Therefore, it appears clear that cardiovascular pathology is a factor to be carefully scrutinised in the preoperative evaluation of the patient, and especially in elderly patients that could have associated risk factors.

Conclusion

CDP is the technique of choice for cephalic ADHP, with an acceptable mortality rate in reference centres. However, postoperative complications appear in almost half of patients. Recently, some clinical guidelines have advised that this surgery should only be practiced in centres that administer

more that 20 CDP/year,[46-49] in order to improve short and long-term results. In light of our findings, we believe that the preoperative clinical management of the patient is critical for reducing postoperative complications. Patient selection, evaluation of nutritional situation, and the improvement of kidney and heart function in the presence of jaundice will all improve results. Elderly patients should also be individually assessed before undergoing a CDP.

Conflict of interest

The authors affirm that they have no conflicts of interest.

REFERENCES

1. Balcom JHt, Rattner DW, Warshaw AL, Chang Y, Fernandez-del Castillo C. Ten-year experience with 733 pancreatic resections: changing indications, older patients, and decreasing length of hospitalization. Arch Surg. 2001;136:391-8.
2. Howard TJ, Krug JE, Yu J, Zyromski NJ, Schmidt CM, Jacobson LE, et al. A margin-negative R0 resection accomplished with minimal postoperative complications is the surgeon's contribution to long-term survival in pancreatic cancer. J Gastrointest Surg. 2006;10:1338-45. Discussion 1345-1336.
3. DeOliveira ML, Winter JM, Schafer M, Cunningham SC, Cameron JL, Yeo CJ, et al. Assessment of complications after pancreatic surgery: A novel grading system applied to 633 patients undergoing pancreaticoduodenectomy. Ann Surg. 2006;244:931-7. Discussion 937-9.
4. Winter JM, Cameron JL, Campbell KA, Arnold MA, Chang DC, Coleman J, et al. 1423 pancreaticoduodenectomies for pancreatic cancer: A single-institution experience. J Gastrointest Surg. 2006;10:1199-210. Discussion 1210-1191.
5. Valls C. Obstructive Jaundice: diagnostic and therapeutic management. J Radiol. 2006;87(4 Pt 2):460-78.
6. Sewnath ME, Karsten TM, Prins MH, Rauws EJ, Obertop H, Gouma DJ. A meta-analysis on the efficacy of preoperative biliary drainage for tumors causing obstructive jaundice. Ann Surg. 2002;236:17-27.
7. Valls C, Andia E, Sánchez A, Fabregat J, Pozuelo O, Quintero JC, et al. Dual-phase helical CT of pancreatic adenocarcinoma: assessment of resectability before surgery. Am J Roentgenol. 2002;178:821-6.
8. Nakao A, Harada A, Nonami T, Kaneko T, Inoue S, Takagi H. Clinical significance of portal invasion by pancreatic head carcinoma. Surgery. 1995;117:50-5.
9. Ishikawa O, Ohigashi H, Imaoka S, Furukawa H, Sasaki Y, Fujita M, et al. Preoperative indications for extended pancreatectomy for locally advanced pancreas cancer involving the portal vein. Ann Surg. 1992;215:231-6.
10. Wagner M, Redaelli C, Lietz M, Seiler CA, Friess H, Buchler MW. Curative resection is the single most important factor determining outcome in patients with pancreatic adenocarcinoma. Br J Surg. 2004;91:586-94.
11. Lillemoe KD, Pitt HA. Palliation. Surgical and otherwise. Cancer. 1996;78(3 Suppl):605-14.
12. Yeo TP, Hruban RH, Leach SD, Wilentz RE, Sohn TA, Kern SE, et al. Pancreatic cancer. Curr Probl Cancer. 2002;26:176-275.
13. Li S, Zhuang GY, Pei YQ, Li CY, Wang JL, Ding W, et al. Extended local resection for treatment of periampullary carcinoma of vater. Hepatobiliary Pancreat Dis Int. 2004;3:303-6.
14. McCulloch P, Nita ME, Kazi H, Gama-Rodrigues J. Extended versus limited lymph nodes dissection technique for adenocarcinoma of the stomach. Cochrane Database Syst Rev. 2004;4:CD001964.
15. Ishikawa O, Ohigashi H, Sasaki Y, Kabuto T, Furukawa H, Nakamori S, et al. Practical grouping of positive lymph nodes in pancreatic head cancer treated by an extended pancreatectomy. Surgery. 1997;121:244-9.
16. Yeo CJ, Cameron JL, Lillemoe KD, Sohn TA, Campbell KA, Sauter PK, et al. Pancreaticoduodenectomy with or without distal gastrectomy and extended retroperitoneal lymphadenectomy for periampullary adenocarcinoma, part 2: randomized controlled trial evaluating survival, morbidity, and mortality. Ann Surg. 2002;236:355-66. Discussion 366-8.
17. Tran KT, Smeenk HG, Van Eijck CH, Kazemier G, Hop WC, Greve JW, et al. Pylorus preserving pancreaticoduodenectomy versus standard Whipple procedure: a prospective, randomized, multicenter analysis of 170 patients with pancreatic and periampullary tumors. Ann Surg. 2004;240:738-45.
18. Nguyen TC, Sohn TA, Cameron JL, Lillemoe KD, Campbell KA, Coleman J, et al. Standard vs. radical pancreaticoduodenectomy for periampullary adenocarcinoma: a prospective, randomized trial evaluating quality of life in pancreaticoduodenectomy survivors. J Gastrointest Surg. 2003;7:1-9. Discussion 9-11.
19. Nakeeb A, Lillemoe KD, Grosfeld JL. Surgical techniques for pancreatic cancer. Minerva Chir. 2004;59:151-63.
20. Hirano S, Kondo S, Ambo Y, Tanaka E, Morikawa T, Okushiba S, et al. Outcome of duodenum-preserving resection of the head of the pancreas for intraductal papillary-mucinous neoplasm. Dig Surg. 2004;21:242-5.
21. Yang YM, Tian XD, Zhuang Y, Wang WM, Wan YL, Huang YT. Risk factors of pancreatic leakage after pancreaticoduodenectomy. World J Gastroenterol. 2005;11:2456-61.
22. Bassi C, Dervenis C, Butturini G, Fingerhut A, Yeo C, Izbicki J, et al. Postoperative pancreatic fistula: an international study group (ISGPF) definition. Surgery. 2005;138:8-13.
23. Buchler MW, Bassi C, Fingerhut A, Klempa I. Does prophylactic octreotide decrease the rates of pancreatic fistula and other complications after pancreaticoduodenectomy? Ann Surg. 2001;234:262-3.
24. Buchler MW, Friess H. Evidence forward, drainage on retreat: still we ignore and drain!? Ann Surg. 2006;244:8-9.
25. Keats AS. The ASA classification of physical status–a recapitulation. Anesthesiology. 1978;49:233-6.
26. Soriano-Izquierdo A, Castells A, Pellise M, Ayuso C, Ayuso JR, De Caralt TM, et al. Hospital registry of pancreatic tumors. Experience of the Hospital Clinic in Barcelona (Spain). Gastroenterol Hepatol. 2004;27:250-5.
27. Boadas J, Balart J, Capella G, Lluis F, Farre A. Survival of cancer of the pancreas. Bases for new strategies in diagnosis and therapy. Rev Esp Enferm Dig. 2000;92:316-25.
28. Fernández-Cruz L, Cosa R, Blanco L, Levi S, López-Boado MA, Navarro S. Curative laparoscopic resection for pancreatic neoplasms: a critical analysis from a single institution. J Gastrointest Surg. 2007;11:1607-21. Discussion 1621-2.
29. Sabater L, Calvete J, Aparisi L, Cánovas R, Muñoz E, Añón R, et al. Neoplasias de páncreas y periampulares: morbimortalidad, resultados funcionales y supervivencia a largo plazo. Cir Esp. 2009;3:159-66.
30. Tani M, Kawai M, Hirono S, Ina S, Miyazawa M, Nishioka R, et al. A pancreaticoduodenectomy is acceptable for periampullary tumors in the elderly, even in patients over 80 years of age. J Hepatobiliary Pancreat Surg. 2009;16:675-80.
31. Ouaissi M, Sielezneff I, Pirro N, Merad A, Loundou A, Chaix JB, et al. Pancreatic cancer and pancreaticoduodenectomy in

elderly patient: morbidity and mortality are increased. Is it the real life? Hepatogastroenterology. 2008;55:2242-6.
32. Boldt J, Ducke M, Kumle B, Papsdorf M, Zurmeyer EL. Influence of different volume replacement strategies on inflammation and endothelial activation in the elderly undergoing major abdominal surgery. Intensive Care Med. 2004;30:416-22.
33. Yeo CJ, Cameron JL, Maher MM, Sauter PK, Zahurak ML, Talamini MA, et al. A prospective randomized trial of pancreaticogastrostomy versus pancreaticojejunostomy after pancreaticoduodenectomy. Ann Surg. 1995;222:580-8. Discussion 588-92.
34. Ohwada S, Satoh Y, Kawate S, Yamada T, Kawamura O, Koyama T, et al. Low-dose erythromycin reduces delayed gastric emptying and improves gastric motility after Billroth I pylorus-preserving pancreaticoduodenectomy. Ann Surg. 2001;234:668-74.
35. Kollmar O, Moussavian MR, Richter S, De Roi P, Maurer CA, Schilling MK. Prophylactic octreotide and delayed gastric emptying after pancreaticoduodenectomy: results of a prospective randomized double-blinded placebo-controlled trial. Eur J Surg Oncol. 2008;34:868-75.
36. Zeng Q, Zhang Q, Han S, Yu Z, Zheng M, Zhou M, et al. Efficacy of somatostatin and its analogues in prevention of postoperative complications after pancreaticoduodenectomy: a meta-analysis of randomized controlled trials. Pancreas. 2008;36:18-25.
37. Shan YS, Sy ED, Tsai ML, Tang LY, Li PS, Lin PW. Effects of somatostatin prophylaxis after pylorus-preserving pancreaticoduodenectomy: increased delayed gastric emptying and reduced plasma motilin. World J Surg. 2005;29:1319-24.
38. Paraskevas KI, Avgerinos C, Manes C, Lytras D, Dervenis C. Delayed gastric emptying is associated with pylorus-preserving but not classical Whipple pancreaticoduodenectomy: a review of the literature and critical reappraisal of the implicated pathomechanism. World J Gastroenterol. 2006;12:5951-8.
39. Riall TS, Cameron JL, Lillemoe KD, Campbell KA, Sauter PK, Coleman J, et al. Pancreaticoduodenectomy with or without distal gastrectomy and extended retroperitoneal lymphadenectomy for periampullary adenocarcinoma–part 3: update on 5-year survival. J Gastrointest Surg. 2005;9:1191-204. Discussion 1204-6.
40. Tani M, Terasawa H, Kawai M, Ina S, Hirono S, Uchiyama K, et al. Improvement of delayed gastric emptying in pylorus-preserving pancreaticoduodenectomy: results of a prospective, randomized, controlled trial. Ann Surg. 2006;243:316-20.
41. Winter JM, Cameron JL, Yeo CJ, Lillemoe KD, Campbell KA, Schulick RD. Duodenojejunostomy leaks after pancreaticoduodenectomy. J Gastrointest Surg. 2008;12:263-9.
42. Molinari E, Bassi C, Salvia R, Butturini G, Crippa S, Talamini G, et al. Amylase value in drains after pancreatic resection as predictive factor of postoperative pancreatic fistula: results of a prospective study in 137 patients. Ann Surg. 2007;246:281-7.
43. Sohn TA, Yeo CJ, Cameron JL, Geschwind JF, Mitchell SE, Venbrux AC, et al. Pancreaticoduodenectomy: role of interventional radiologists in managing patients and complications. J Gastrointest Surg. 2003;7:209-19.
44. Aimoto T, Uchida E, Nakamura Y, Matsushita A, Katsuno A, Chou K, et al. Efficacy of a Blake drainR on pancreatic fistula after pancreaticoduodenectomy. Hepatogastroenterology. 2008;55:1796-800.
45. Lin JW, Cameron JL, Yeo CJ, Riall TS, Lillemoe KD. Risk factors and outcomes in postpancreaticoduodenectomy pancreaticocutaneous fistula. J Gastrointest Surg. 2004;8:951-9.
46. Nordback L, Parviainen M, Raty S, Kuivanen H, Sand J. Resection of the head of the pancreas in Finland: effects of hospital and surgeon on short-term and long-term results. Scand J Gastroenterol. 2002;37:1454-60.
47. Guidelines for the management of patients with pancreatic cancer periampullary and ampullary carcinomas. Gut. 2005;54(Suppl 5):v1-v16.
48. NCCN practice guidelines for pancreatic cancer. Oncology (Williston Park). 1997;11:41-55.
49. DiMagno EP, Reber HA, Tempero MA; American Gastroenterological Association. AGA technical review on the epidemiology, diagnosis, and treatment of pancreatic ductal adenocarcinoma. Gastroenterology. 1999;117:1464-84.