

ORIGINAL ARTICLE

A reduced time to surgery within a 'fast track' pathway for periampullary malignancy is associated with an increased rate of pancreatoduodenectomy

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Abstract

Introduction: Pancreatoduodenectomy (PD) typically follows preoperative biliary drainage (PBD) despite PBD being potentially harmful. This study evaluated a pathway to avoid PBD within the framework of the UK's NHS.

Method: A prospective observational study of jaundiced patients undergoing PD for periampullary cancer. A pathway to provide early surgery without PBD was introduced at the start of the study period.

Results: Over 12 months 61 and 32 patients underwent surgery with and without PBD respectively; 95% of patients in the PBD group had been stented before referral. The time from CT scan to surgery was shorter in the no PBD group (16 vs 65 days, $p < 0.0001$). Significantly more patients underwent PD in the no PBD group (31/32 vs 46/61, $p = 0.009$) and venous resection (10/31 vs 4/46, $p = 0.014$). The sensitivity of initial CT scan to define borderline resectable disease was worse in the PBD group (91 vs 50%, $p = 0.042$).

Conclusions: Early surgery to avoid PBD is possible within the NHS. By reducing the time to surgery it appears that more patients undergo potentially curative resection. It is desirable to understand why surgery without PBD is not performed routinely as are the development of strategies to support its more widespread practice.

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Introduction

Pancreaticoduodenectomy (PD) is the only potentially curative treatment for patients with periampullary malignancy, but is associated with significant morbidity.^{1–5} Obstructive jaundice, the presenting symptom in the majority of patients,^{6,7} has historically been associated with an increased incidence of perioperative complications, in particular sepsis, renal failure and haemorrhage.^{8–10} In order to minimise these risks, preoperative biliary drainage (PBD) became standard practice prior to PD.^{11,12} However, PBD is unpleasant, takes time to organise and associated with risks, particularly cholangitis and pancreatitis which may either delay surgery or preclude resection by obliterating tissue planes. Indeed, it has been previously demonstrated in randomised trials that the risks of PBD are higher than the risks of operating on jaundiced patients,¹³ and PD without

PBD has been recommended in patients with serum bilirubin less than 250 $\mu\text{mol/L}$.⁷ Despite the available evidence, the majority of patients with potentially resectable periampullary cancers continue to be referred to specialist pancreatic units after biliary drainage.¹²

The reasons for failure to widely adopt a 'straight to surgery' approach are multi-factorial. Reluctance amongst pancreatic surgeons to operate on patients with high bilirubin combined with a lack of resources and infrastructure appear partly responsible. Given that serum bilirubin increases at approximately 100 $\mu\text{mol/L}$ per week among patients with malignant obstructive jaundice¹⁴ and previous studies adopted an arbitrary threshold bilirubin of 250 $\mu\text{mol/L}$ ⁷ it is clear that surgery needs to be performed within a couple of weeks of presentation for the majority of patients. In itself this presents significant

organisational and logistic challenges^{15,16} made more complex by the need to be confident of the diagnosis and staging.

In our unit, a fast track PD pathway was developed and implemented in order to deliver PD to patients without PBD. The aims of the present study are to report on the feasibility of the pathway, and to evaluate early postoperative outcomes.

Methods

This was a prospective observational study of patients undergoing PD at a specialist service in the United Kingdom.

The service takes referral of patients with pancreatic disease from nine NHS Trusts (fourteen hospitals). A pathway was developed to treat jaundiced patients with potentially resectable periampullary cancer specifically to avoid PBD.

Summary of pathways

Referring teams were asked to consider referral of jaundiced patients with suspicion of periampullary malignancy to the 'fast track' pathway. The pathway is summarised in Fig. 1.

Staging laparoscopy or PET scanning were not routinely performed. Endoscopic ultrasound (EUS) and MRI were used selectively in cases of diagnostic doubt or of suspected liver metastases. The need for these procedures was anticipated at initial review of the CT and arranged at that point.

Patients in the no PBD group received 10 mg intravenous phytomenadione (vitamin K) at the point of referral and the night before surgery regardless of their preoperative INR.

Patients in the PBD group were booked into the next available MDT, clinic and elective theatre space. This was the same for patients with other malignant pancreatic, liver or biliary disease treated by the same surgical service.

Patient selection

Over a 12 month period (1st August 2015–31st July 2016) some 145 patients underwent attempted PD. Fifty two patients at the point of referral were not suitable for the pathways being considered within this study so were excluded (no jaundice $n = 37$, borderline resectable pancreatic cancer referred for neoadjuvant chemotherapy $n = 9$, emergency transfer with gastric outlet obstruction $n = 5$, frail at initial review and surgery deferred $n = 1$).

Thus 93 patients were potentially eligible for surgery without PBD and comprised the study group. Inclusion and exclusion criteria are presented in Table 1.

Statistical analysis

Data was recorded prospectively by two researchers (PP and KR). Complications were recorded prospectively by a dedicated data manager (Chris Coldham). Perioperative mortality was defined as any death within 90 days of surgery. Data was analysed using

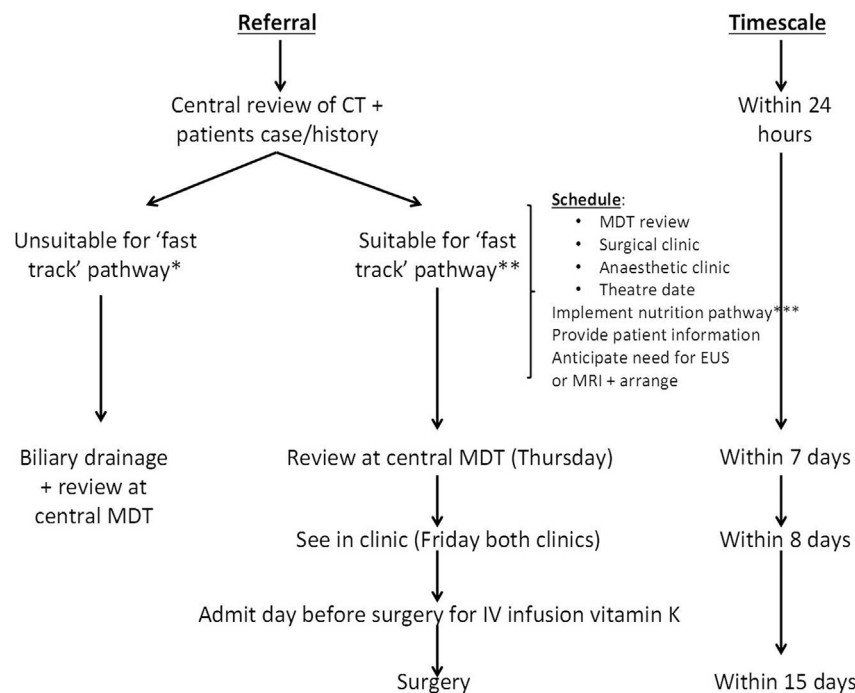


Figure 1 Summary of 'fast track' pathway. This pathway was used for most patients. For those with a very high bilirubin at referral ($>350 \mu\text{mol/L}$) treatment was expedited to surgery within 7 days of referral. *See Table 1 for suitability to 'fast track' surgery. ***Pancreatic enzyme replacement therapy (75,000–100,000 μ with meals and 50,000 μ with snacks) and proton pump inhibitor. Low fat diet

Table 1 Summary of inclusion and exclusion criteria for surgery without preoperative biliary drainage (PBD)

Variable	Inclusion criteria	Exclusion criteria
Biliubin at the time of surgery ^a	Likely to be <450 µmol/L	Likely to be >450 µmol/L
Venous involvement	SMV/PV involvement with potential for surgical reconstruction	Complete occlusion of SMV/PV and/or without possibility of for surgical reconstruction ^b
Involvement of SMA or celiac axis	None	All ^b
Biliary sepsis	None	All
Renal dysfunction	If this could be corrected with short duration of fluid replacement therapy	If this could not be corrected with a short duration of fluid replacement therapy
Performance status	WHO <2	WHO 2+
Age and/or comorbidity	Not a contraindication to early surgery outside of the usual assessment of fitness for PD	

^a Initially an upper limit of bilirubin of 300 µmol/L was used as a cut off for the selection of patients to the 'fast track' pathway but this increased to 400 µmol/L and is presently 450 µmol/L.

^b These patients were selectively referred for PBD and 'downstaging' chemotherapy. SMV, superior mesenteric vein; PV, portal vein; SMA, superior mesenteric artery.

SPSS v22, Armonk, New York, USA. Categorical data was analysed using Fishers exact test and continuous data with the Mann Whitney *U* test. Tests were 2 tailed with a *p* value of <0.05 considered significant.

Results

Over the 12 month period some 93/145 patients were jaundiced at presentation, considered fit for surgery and had resectable periampullary cancer. Sixty one patients underwent surgery after PBD and 32 without PBD. Among the patients who underwent PBD 58 (95%) had biliary drainage performed before referral and without discussion with the specialist team. Diagnostic delays combined with a high serum bilirubin led to two patients requiring PBD after referral and one patient underwent PBD early in the series as her bilirubin was considered too high (376 µmol/L) for early surgery. Thus 3/61 patients in the PBD group were initially considered for early surgery without PBD but could not proceed down that pathway.

Table 2 The pathway from initial CT scan to surgery as defined by key periods

Interval	PBD n = 61	No PBD n = 32	p
CT to referral	16 (1–67)	2 (0–15)	<0.0001
Referral to MDT	4 (0–54)	2 (0–10)	0.003
MDT to clinic	8 (0–43)	1 (–2 ^a –6)	<0.0001
Clinic to surgery	25 (5–153)	7 (2–21)	<0.0001
TOTAL: CT to surgery	65 (9–181)	16 (8–39)	<0.0001

Data is expressed in days and is the median (range).

^a Occasionally patients were seen ahead of the MDT to save time, particularly when the bilirubin was towards the higher end of what was considered acceptable. PBD, preoperative biliary drainage; MDT, multidisciplinary team meeting; Mann Whitney *U* test.

Therefore of 34 patients who were potentially eligible for surgery without PBD 31 (91%) successfully underwent surgery without PBD.

There was no significant difference in the bilirubin at presentation between the two cohorts (Table 3). The median bilirubin at the time of surgery among patients in the no PBD groups was 306 (78–461). To understand the potential maximum number of patients in the PBD group who could have been eligible for surgery without PBD the levels of bilirubin at the time of CT were identified. This was possible for 53 (85%) patients. Among these the median bilirubin was 200 µmol/L (range 29–585 µmol/L); some 34 (64%), 40 (75%), 45 (85%), 48 (91%) and 50 (94%) patients had a serum bilirubin under 250, 300, 350, 400 and 450 µmol/L respectively.

Analysis of the pathway from diagnosis to surgery

Within the pathway the following time points were considered – the dates of the initial CT scan, of referral to the pancreatic team, of discussion at pancreatic MDT, of review in pancreatic clinic and of surgery. Every interval in the pathway was significantly shorter for patients proceeding without PBD (Table 2). The time from CT to referral was shorter (2 vs 16 days, *p* < 0.0001) indicating that the change in practice in tertiary care affected practice in secondary care. The total time from initial CT to surgery was 16 days in the no PBD group vs 65 days in the PBD group (*p* < 0.0001).

The proportion of patients undergoing surgery without PBD increased steadily during the study period; during the first and final two month periods of the study some 25 and 56%, respectively, of patients under surgery without PBD (Fig. 2).

Some 8 patients in the no PBD group (25%) required an EUS (*n* = 6) or MRI (*n* = 2) because of diagnostic uncertainty or of suspicion of liver metastases after referral. The need for these procedures was recognised at initial screening by the pancreatic team and investigations were planned at that point together with

Table 3 Summary of the study cohorts

		PBD n = 61	No PBD n = 32	p
Gender male/female		31/30	19/13	0.679
Age [median (range)]		69 (51–88)	67 (49–82)	0.162
Smoker		2	5	0.045
Asthma		6	3	1
Chronic obstructive lung disease		2	0	0.544
Diabetes		17	10	0.811
Hypertension		33	13	0.276
Myocardial infarction		2	1	1
Cerebrovascular accident		0	2	0.116
CKD (stage 3 or 4)		2	0	0.544
Bilirubin at presentation, median (range)		200 (29–585)	173 (43–347)	0.235
Bilirubin at surgery, median (range)		21 (5–355*)	306 (78–461)	<0.001
Cancer origin	Pancreas	46	29	0.168
	Bile duct	5	2	
	Ampulla	10	1	
Venous involvement on initial CT		7	10	0.025
Venous/arterial involvement surgery		14	11	0.303
Surgical procedure	Resection	46	31	0.009
Venous resection with PD	No	42	21	0.014
	Yes	4	10	

Statistical analysis is with the Mann Whitney *U* test or Fishers exact test. PBD, preoperative biliary drainage; CKD, chronic kidney disease; PD, pancreaticoduodenectomy.

*One patient in the PBD group had evidence of stent occlusion but no sepsis so proceeded to surgery on the day of planned surgery.

clinic appointments and a date for potential surgery. Early in the study period a further two patients initially considered for surgery without PBD required EUS but this could not be arranged within a suitable time frame and there were concerns over the rate of increase of bilirubin. These two patients both then underwent PBD as outlined above.

Study cohorts, resectable and non resectable disease

A comparison of the two groups is provided in Table 3. There was no significant difference in the gender, age or comorbidity of patients or underlying tumour type between the cohorts undergoing surgery with or without PBD. More patients in the no PBD group had evidence of venous involvement on initial staging CT but by

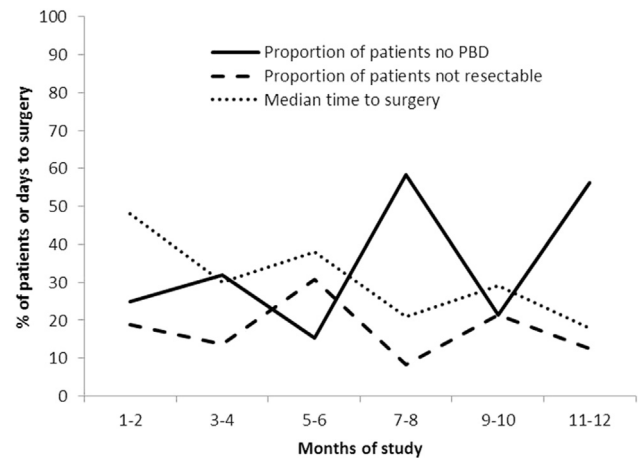


Figure 2 Characteristics of the cohort at surgery. Over the study period the proportion of patients undergoing surgery without PBD fluctuated but steadily increased (unbroken line). Periods when rates of surgery without PBD were at the highest corresponded to periods with the lowest rate of unresectable disease being found at surgery (broken dashed line). The median time from CT scan to surgery (dotted line) closely correlated with the proportion of patients found with unresectable disease at surgery

the time of surgery there was no difference (Table 3). A significantly higher proportion of patients underwent surgical resection in the no PBD group (31/32 vs 46/61 [97 vs 75%], $p = 0.009$). This was associated with a higher proportion of patients undergoing associated venous resection in the no PBD group.

At the time of surgery one patient in the no PBD group and 10 in the PBD group were found to have tumours that could not be resected because of widespread venous and/or arterial involvement. A further 6 patients underwent surgical bypass in the PBD group, 5 were found to have metastatic disease at laparotomy and one had evidence of severe pancreatitis (which had occurred after PBD) with necrosis and was technically unresectable.

Of the eleven and fourteen patients with venous and/or arterial involvement at surgery, ten and seven respectively, in the PBD and no PBD groups had evidence of venous involvement at initial staging CT. The sensitivity of initial staging CT with regards to correctly staging borderline resectable venous and/or arterial disease was therefore 91 and 50% in the no PBD and PBD groups respectively, $p = 0.042$. The negative predictive value of the initial CT scan to identify metastatic disease was 100 and 91.8% in the no PBD and PBD groups respectively.

The relationships between the proportion of patients undergoing surgery without PBD, the proportion of patients who were unresectable at surgery and of the median time from initial CT to surgery is shown in Fig. 2.

The relationship between time from CT scan to surgery and the proportion of patients found to be unresectable at surgery is shown in Fig. 3.

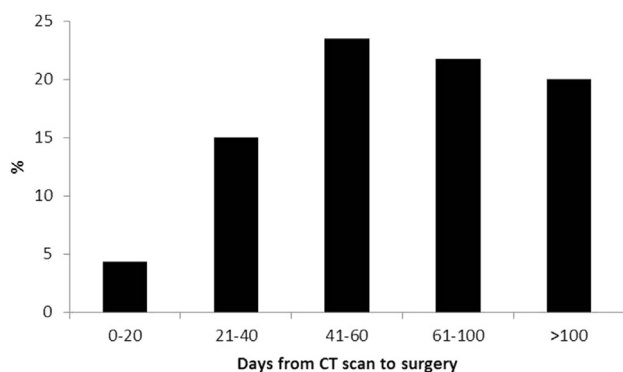


Figure 3 The proportion of patients found to be unresectable at surgery stratified by time from initial CT scan

There was one death within 90 days of surgery in each group; there was no significant difference in post operative complications between groups. In total 25/61 (41%) and 15/32 (47%) patients in the PBD and no PBD groups respectively had complications with 7/61 (12%) and 7/32 (22%) having Clavien-Dindo grade 3+ complications ($p = 0.226$). Table 4 summarises the data along with other complications, stratified by Clavien-Dindo severity.

Patients with pancreatic ductal adenocarcinoma were analysed separately to further study pathologic variables and avoid heterogeneity of analysing patients with different tumour types.

There was no significant difference in patient variables or levels of Ca19-9 at surgery, T, N, lymph node ratio, R stage or tumour size between patients in the PBD ($n = 46$) and no PBD ($n = 29$) groups (Supplementary Table 1). A higher proportion of patients underwent resection (28/29 vs 32/46, $p = 0.006$) in the no PBD group though the difference in proportion of patients undergoing venous resection became non significant (10/28 vs 4/32 [35 vs 13%], $p = 0.064$).

Discussion

This is an observational study of patients with jaundice due to periampullary malignancy undergoing attempted PD at a single centre. The study represents the first 12 months following the introduction of a dedicated pathway aimed at avoiding PBD within the framework of the English National Health Service. The main finding was that the pathway could be implemented with one third of patients undergoing surgery without PBD which was associated with a large reduction in the time to surgery. Furthermore the proportion of patients undergoing surgery without PBD increased over the study period. This partly reflects the staged introduction of the pathway at referring Trusts which was implemented in this manner to avoid overloading the system with referrals and to reduce the risk of pathway failure. The increase in proportion of patients undergoing early surgery also likely reflects increased recognition and use of the pathway.

Table 4 Postoperative complications and mortality (within 90 days of surgery)

	PBD (n = 61)							No PBD (n = 32)							p
	CD grade of complication							CD grade of complication							
	1	2	3a	3b	4a*	5	Total	1	2	3a	3b	4a*	5	Total	
Pneumonia	1	1			1		3 (4.9)						1	1 (3.1)	1
Dysrhythmia		2					2 (3.3)							0	0.544
Myocardial infarction		1					1 (1.6)							0	1
POPF	4	4	1				9 (19.6)		2	1				3 (9.7)	0.535
POPF grades a/b/c	4/4/1							0/2/1							
DGE	3	1					4 (6.6)		1					1 (3.1)	1
Bile leak		1	2				3 (4.9)			1				1 (3.1)	1
Haemorrhage		1		1		1	3 (4.9)				5			5 (15.6)	0.118
Acute kidney injury			1				1 (1.6)	1						1 (3.1)	1
Urinary tract infection	1						1 (1.6)							0	1
Abscess/sepsis		1	1				2 (3.3)							0	0.544
Confusion		1					1 (1.6)							0	1
Wound infection	2	1					3 (4.9)	1						1 (3.1)	1
C difficile infection		1					1 (1.6)							0	1
90 Day mortality							1 (1.6)							1 (3.1)	1

All complications are presented; for example if a patient had two complications the grade and type of both complications are presented. Data is expressed as n (%). Fishers exact test. PBD, preoperative biliary drainage; CD, Clavien-Dindo; POPF, post operative pancreatic fistula; DGE, delayed gastric emptying.

*No patient had a grade 4b complication.

When designing the pathway it was clear there are two main barriers to early surgery – firstly the logistics of providing early surgery within the specialist teams host organisation and secondly the behaviour and practice of referring teams. To overcome this latter problem a specialist surgeon and nurse visited the referring teams to raise awareness and introduce the pathway. Many patients with PBD however continued to be referred from teams who were aware of the pathway. This has been observed in other healthcare systems that provide early surgery to avoid PBD.¹⁷ There appear to be several reasons for this. In some cases the referring teams had decided the bilirubin levels were too high, often rightly so according to the limits as defined within the pathway, but sometimes not. Other times, however, patients had proceeded directly to endoscopic investigation of jaundice at the referring hospital without a prior CT. Thus physicians were presented with a dilemma of what to do when faced with a malignant appearing stricture at endoscopy. A third common problem was that information regarding the pathway had not filtered to all physicians in each referring centre. These insights present opportunities to further increase the proportion of patients undergoing early surgery.

A third problem became evident that had not been anticipated which required a change to the pathway. This was the emotional impact upon patients related to rapid progression through the pathway. It was assumed that patients would welcome early surgery (which was universal) but it became clear that sometimes patients were coming to the specialist clinic unaware of their diagnosis, prognosis, of the role of the specialist team and need for major surgery. Thus these patients were presented with this information on the same day they were due to see the anaesthetic team and then had to prepare themselves for surgery within 7 days. For this reason the pathway evolved to include checks that patients had been made aware of this information. This was supported by the pathway nurse who also helped ensure compliance with other aspects of the pathway such as nutrition and the organisation of clinic appointments, investigations and surgery. We are not aware of any qualitative work that assesses the impact of early or delayed surgery upon patients but it became clear that this is an essential part of the pathway.

A review of the pathway from CT to surgery is revealing. Firstly the median interval to referral among clinicians not aware of the early surgery pathway was over two weeks following CT scan. In the majority of cases clinicians were waiting for biliary drainage and/or discussion at local MDT before referring patients despite diagnostic information from CT scans being available. Secondly clinicians responded to the new pathway given that the median time to referral was just two days following CT in those patients undergoing surgery without PBD. Thirdly, following referral, minimal effort or changes to the pathway within specialist care were required to shorten the pathway to discuss patients at the specialist MDT and see them in clinic; these changes were associated with a median reduction of 2 and 7 days respectively compared to patients in the PBD pathway.

Finally, providing early surgery is a challenge but it reduced the time to surgery following the clinic appointment by 18 days. The median reduction in time between CT and clinic appointment was more than the reduction in time from clinic to surgery (21 and 18 days respectively). So whilst many surgeons view the provision of a theatre space as a major barrier to early surgery modification to other parts of the pathway actually had a greater effect upon the reduction in time to surgery. The final observation is that the stented pathway is associated with a remarkably long interval, in excess of two months, between initial CT scan and definitive treatment even when the interval between specialist clinic review and surgery was under four weeks.

Patients proceeding to early surgery without PBD had a greater likelihood of resection. Selection bias is clearly a risk with this observational study, however, the treatment pathway for the majority of patients was determined *prior to referral* with 95% of patients in the PBD group having undergone PBD before referral whilst over 90% of patients considered for early surgery to avoid PBD successfully proceeded down this pathway; consequently, there appears limited potential for selection bias to the two different pathways by the specialist team. This is an important point given the higher rate of resection among the no PBD group.

This observation is worth debate. Unresectable disease identified at laparotomy is one of the Achilles heels of PD and reflects the rapidly progressive nature of the underlying cancer. Strategies to increase the proportion of patients undergoing successful resection are urgently required but there is conflicting evidence that early surgery facilitates this. Of the randomised trials to study a role for early surgery without PBD none have demonstrated a higher resection rate with a reduced time to surgery.^{7,18–22} There was a shorter interval to surgery between the early surgery and PBD groups in the Dutch RCT than the present study (28 vs 49 days respectively) which may be partly responsible for this difference. It may be that strategies to treat borderline resectable disease play an important role. The rate of venous resection was not reported in the recent Dutch RCT. Given that the Netherlands pancreatic centres are relatively low volume (high volume in the Netherlands has been defined as ≥ 20 cases per annum²³) it is assumed that venous resection was less likely to have been performed than in the present study. This is perhaps supported by observing the high proportion of patients undergoing bypass in both groups in the Dutch trial (32.6 and 38.9% in the no PBD and PBD groups). In contrast, a recently published collaborative study between the Karolinska and Mayo Clinic groups²⁴ demonstrated that the duration between initial CT and surgery did affect the resection rate. In that study every patient who underwent surgery within 3 weeks of CT scan were resected. Patients undergoing surgery after 32 or more days from initial CT had twice the likelihood of being unresectable than those whose surgery was under that time. In the present cohort some 8% and 23% of patients were unresectable when the time to surgery was under or over 32 days respectively.

The accuracy of the initial CT scan to define resectable venous disease appears to be adversely affected by increasing time to surgery.

There is further supporting evidence that a matter of weeks impacts upon the likelihood of successful resection of pancreatic cancer. It has been estimated that at presentation pancreatic ductal adenocarcinoma is in an exponential phase of growth and that almost all, if not all, tumours harbour metastasis enabled cells within the primary tumour.²⁵ The occurrence of metastatic disease has been demonstrated to be strongly associated with the interval between imaging and surgery.²⁶ A recent study identified the need to repeat imaging after 25 days without surgery due to the rapid appearance of metastatic disease in this short time period.²⁷

It is not unreasonable to assume that a proportion of patients who underwent early resection in the present study will have occult metastatic disease that was not visible at the time of early surgery but would have been had surgery been performed several weeks later. Only longitudinal follow up will address this issue. However there is no reason why additional staging, for example with PET or MRI,²⁸ as part of a strategy to identify patients with occult metastatic disease cannot be used within an early surgery program. The logistic challenge does not appear insurmountable as some 25% of patients in the present study proceeding without PBD to early surgery had either or both an MRI liver and EUS between the point of referral and surgery. By streamlining pathways and through ad hoc discussion with colleagues it was possible to arrange these investigations and the analysis of material/data often within a matter of days or at most a week. This improved over the study period with increasing recognition and familiarity with the pathway and by the appointment of the pathway nurse.

A further area of uncertainty is what is the safe upper limit of bilirubin for patients to undergo PD without PBD? It is unlikely that the answer will lie in an absolute value viewed in isolation. The recent Dutch RCT used a cut off bilirubin of 250 $\mu\text{mol/L}$ at randomisation⁷ or 300 $\mu\text{mol/L}$ at surgery²⁹ though these levels appear to have been arbitrarily selected. There is evidence of increased perioperative complications among severely jaundiced patients ($>300 \mu\text{mol/L}$) undergoing surgery without PBD.³⁰ However that large multicentre observational study included many patients with a bilirubin way in excess of 300 $\mu\text{mol/L}$ and furthermore these complications were considered in isolation i.e. without being offset by avoiding complications associated with PBD. Thus it is presently not known at what level of bilirubin the overall complications of a 'straight to surgery' approach exceeds the total number of complications of PBD and subsequent surgery. The pathway within the present study was regularly audited to review complications and outcomes; with experience the upper limit of bilirubin was increased. There has been no clear difference in complications between those patients undergoing PD with or without PBD. Our current assessment includes a global assessment of the patient and their co morbidity. Jaundice

and renal impairment is, however, considered a strong contra-indication. There is also evidence that a high pre surgery bilirubin correlates with reduced long term survival³⁰ and thus adds to the argument of early definitive treatment.

Ideally the pathway will be supported in the long term by the dedicated pathway nurse who coordinates referral, schedules appointments and investigations and communicates with referring teams and patients. A formal cost analysis has not been performed but it is estimated that each patient that avoids PBD reduces the costs of treatment by £2500.³¹ The dedicated pathway nurse is viewed as key to continuing to provide this service given their role in coordinating referrals, scheduling appointments and investigations and communication with referring teams and patients. It is hoped that long term funding for the pathway nurse can be secured by offsetting the cost saving associated with avoiding PBD and its complications.

In conclusion this study demonstrates that a straight to surgery pathway can be successfully implemented within a large organisation such as the NHS. Furthermore, it adds evidence that early surgery increases the likelihood of successful resection albeit with a high rate of associated venous resection. There are barriers to achieving early surgery without PBD – some more obvious than others. Defining these is essential if such practice is to become routine. Given these results clinicians, commissioning bodies and executives should urgently assess and optimise pathways for patients with potentially resectable pancreatic cancer.

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Conflict of interest

None to declare.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at <http://dx.doi.org/10.1016/j.hpb.2017.04.011>.