IMPACT OF FAST-TRACK CONCEPT ELEMENTS IN THE CLASSICAL PANCREATIC HEAD RESECTION (KAUSCH-WHIPPLE PROCEDURE)

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The aim of the study was to determine statistically significant factors with an impact on the early postoperative surgical outcome.

Material and methods. The influence of applied fast-track components on surgical results and early postoperative outcome in 143 consecutive Kausch-Whipple procedure patients was evaluated in a single-center retrospective analysis of a prospective collection of patient-associated pre-, peri- and postoperative data from 1997-2006.

Results. The in-hospital mortality rate was 2.8% (n=4). Fast-track measures were shown to have no effect on the morbidity rate in the multi-variate analysis. Over the study period, a decrease of intra-operative infusion volume from 14.2 mL/kg body weight/h in the first year to 10.7 mL/kg body weight/h in the last year was accompanied by an increase in patients requiring intraoperative catecholamines, up from 17% to 95%. The administration of ropivacain/sufentanil via thoracic peri-dural catheter injection initiated in 2000 and now considered the leading analgesic method, was used in 95% of the cases in 2006. Early extubation rate rose from 16.6% to 57.9%.

Conclusions. Fast-track aspects in the perioperative management have become more important in several surgical procedure even in those with a greater invasiveness such as Kausch-Whipple. However, such techniques used in peri-operative management of Kausch-Whipple pancreatic-head resections had no impact on the morbidity rate. In addition, the low in-hospital mortality rate was particularly attributed to surgical competence.

Key words: Kausch-Whipple pancreatocoduodenectomy – perioperative management – fast-track concepts – surgical results – early postoperative outcome

Advantages of fast-track rehabilitation have been found in particular in surgical interventions of less and moderate invasiveness (1). However, in more complex surgical interventions associated with higher morbidity and mortality impact of multimodal perioperative concepts is still unsatisfyingly investigated, e.g., in pancreatic-head resection as extended surgical intervention of the abdominal-surgery profile for the treatment of carcinoma and chronic pancreatitis with a considerable but known accompanying morbidity.

*) Both authors are equally involved in study evaluation, manuscript draft and final proof- reading; therefore, Dr Gastinger and Dr Meyer have to be considered first authors.
Derived from this, 2 objectives have been pursued:

- what perioperative criteria for the option and value of fast-track management can be established in this type of complex but well standardized surgical intervention;
- were changes in the outcome (in particular, quality of the surgical result) detectable after the inauguration and optimizing establishment of such management.

MATERIAL AND METHODS

Data of all 143 patients who had undergone Kausch-Whipple procedure (partial duodenopancreatectomy) at the Carl-Thiem Hospital in Cottbus (Germany) during the time period from 01/01/1997 to 12/31/2006 were analyzed with regard to the perioperative management. In particular, data on all relevant surgical and anesthesiological aspects including those obtained in intensive care were prospectively registered out of the computer-based patient records and clinical data registries, e.g., on general anesthesia, stay on the intensive care unit, and prospectively evaluated – initially with following descriptive statistics. To elucidate changes over the years during the study period, patients were subdivided into 10 groups according to the single years.

The aim was to determine statistically significant factors with an impact on the early postoperative surgical outcome.

Statistics

For descriptive statistics, mean and standard deviations (as reasonable), median and minimum (min.) and maximum (max.) were determined and are shown. Further statistics were performed using SPSS® (version 16; SPSS Inc.) by the following tests:

- two sample t test,
- one-way ANOVA, post-hoc tests via Tukey adjustment for multiple comparisons,
- chi-square test for frequencies.

Furthermore, a selective multiple assessment of factors with an impact on the criterion “general complications” was performed by means of a logistic regression model.

In particular, the following specific questions were pursued with regard to endpoints such as early postoperative specific morbidity, early postoperative general morbidity as well as hospital lethality: have been there effects over time during the study period by changes of the perioperative management detectable, e.g., by inauguration of elements and aspects of the fast-track concept with regard to:

- changes of intraoperative infusion therapy,
- differences in the use of catecholamines,
- changes of transfusion therapy,
- modifications of perioperative analgesia.

RESULTS

Patients

During the study period from 01/01/1997 to 12/31/2006, 143 patients underwent Kausch-Whipple procedure (partial duodenopancreatectomy). Mean of age at the time of surgical intervention was 57.5 ± 11 (median, 59.8; min., 12.9; max., 77.7) years. On average, 14.3 (min., 7; max., 21) patients per year were operated. Patients were subdivided into two groups: Tumor lesion (71.3% of patients) or chronic pancreatitis (28.7% of patients). With regard to the surgical and anesthesiological risk, both patient groups were comparable due to standardized surgical technique and standardized general anesthesia.

Intraoperative infusion therapy

The total infusion volume (crystalloids and colloids) per patient was on average 3,784 ± 1,394 (Median: 3,500; min.: 1,300; max.: 10,000) mL. Over the study period, there was a reduction of the mean intraoperative body weight- and operating time-adapted infusion volume detectable. Specifically, intraoperative infusion volume decreased from 14.2 mL/kg b.w./h within the 1st year of the study period (1997) to 10.7 mL/kg b.w./h within the last year (2006) (fig. 1).

Treatment using catecholamines

Intraoperatively, 86 patients (61.4%) received catecholamines. There was a distinct
relative increase of patients with intraoperative administration of catecholamines from 17% within 1997 to 95% within 2006. In the majority of cases, various catecholamines were combined: In 48 patients (34.3%), dopamine was used, in 37 cases (26.4%) noradrenaline, in 19 subjects (13.6%) dobutamine, and in 2 individuals (1.4%) adrenaline. Since the middle of 2004, dopamine has not been used anymore. Over the last year of the study period, a distinct trend was observed to use noradrenaline, frequently combined with dobutamine (fig. 2).

Intraoperative substitution of blood products

During the study period, the portion of patients with intraoperative need of transfusion as well as the number of red cell packages per operated patient could be reduced (fig. 3). The same was observed for the transfusion of fresh frozen plasma.

Intraoperative administration of platelets and substitution of coagulation factors were not statistically evaluated since there was only a small number of cases who needed it or units given.

Analgetic therapy

Within the reporting department of surgery, thoracic peridural catheter was introduced into clinical routine in 2000. During the up-coming years, this catheter was increasingly used (p=0.003). A contradictory development was found in the portion of patients who received piritramide via PCA pump (p<0.001). Simultaneously, metamizol was used more and more as additional analgetic drug, however, there was only an increasing trend (p=0.075) (fig. 4).

Investigating the impact of the leading mode of analgetic treatment (piritramide via PCA pump vs. rofibacain / sufentanil via thoracic peridural catheter) onto various parameters characterizing clinical course, only the early postoperative initiation of tea showed a statistically significant effect (tab. 1, 2). While mean duration of postoperative artificial respiration did not change by inauguration of the thoracic peridural catheter, rate of early postoperative extubation could be increased (fig. 5).
Impact of fast-track concept elements in the classical pancreatic head resection (Kausch-Whipple procedure)

Table 1. Impact of the type of analgetic treatment such as ‘Piritramide via PCA’ onto perioperative parameters

<table>
<thead>
<tr>
<th></th>
<th>PCA</th>
<th>No PCA</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Postoperative time of artificial respiration (h)</td>
<td>12</td>
<td>10,0</td>
<td>0,327</td>
</tr>
<tr>
<td>Postoperative initiation of enteral administration of tea (d)</td>
<td>3,1</td>
<td>2,6</td>
<td>0,002</td>
</tr>
<tr>
<td>1st postoperative stool excretion (d)</td>
<td>4,4</td>
<td>4,2</td>
<td>0,405</td>
</tr>
</tbody>
</table>

PCA = patient controlled analgesia

Table 2. Impact of the analgetic treatment ‘Ropivacain/Sufentanil’ via thoracic peridural catheter onto perioperative parameters

<table>
<thead>
<tr>
<th></th>
<th>PDC</th>
<th>No PDC</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Postoperative time period of artificial respiration – mean (h)</td>
<td>10,1</td>
<td>12,1</td>
<td>0,324</td>
</tr>
<tr>
<td>Postoperative initiation of enteral administration of tea (d)</td>
<td>2,6</td>
<td>3,2</td>
<td>0,001</td>
</tr>
<tr>
<td>1st postoperative day of stool excretion (d)</td>
<td>4,3</td>
<td>4,4</td>
<td>0,702</td>
</tr>
</tbody>
</table>

PDC = peridural catheter

Bowel movement

60.8% (n=87) of individuals reported stool excretion until the 4th postoperative day (mean, 4.3 d).

Specific complications

The rate of specific complications was 16.9% (tab. 3). Using univariate analysis of the fast-track measures showing changes during the study period, there were no factors with significant impact onto the early postoperative specific morbidity (tab. 4).

General complications

Investigating all measures with changes during the study period, univariate analysis re-

Table 3. Specific complications and re-interventions (n (%))

<table>
<thead>
<tr>
<th></th>
<th>Powiklania / Complications</th>
<th>Ponowne interwencje / Re-interventions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gastric atonia / gastric outlet syndrome</td>
<td>9 (6,3)</td>
<td>0</td>
</tr>
<tr>
<td>Anastomotic insufficiency:</td>
<td>9 (6,3)</td>
<td>7 (77,8)</td>
</tr>
<tr>
<td>– pancreatecodigestive anastomosis</td>
<td>4 (2,8)</td>
<td>3</td>
</tr>
<tr>
<td>– biliodigestive anastomosis</td>
<td>4 (2,8)</td>
<td>3</td>
</tr>
<tr>
<td>– gastroenterostomy</td>
<td>1 (0,7)</td>
<td>1</td>
</tr>
<tr>
<td>Septic wound complication:</td>
<td>8 (5,6)</td>
<td>6 (75)</td>
</tr>
<tr>
<td>– distracted wound margins</td>
<td>3 (2,1)</td>
<td>3</td>
</tr>
<tr>
<td>– abscess</td>
<td>3 (2,1)</td>
<td>2</td>
</tr>
<tr>
<td>– wound infection</td>
<td>2 (1,4)</td>
<td>1</td>
</tr>
<tr>
<td>Peritonitis</td>
<td>3 (2,1)</td>
<td>3 (100)</td>
</tr>
<tr>
<td>Postoperative bleeding within the surgical field</td>
<td>5 (3,5)</td>
<td>3 (60)</td>
</tr>
<tr>
<td>Pancreatitis of the remnant</td>
<td>5 (3,5)</td>
<td>0</td>
</tr>
<tr>
<td>Ileus</td>
<td>1 (0,7)</td>
<td>0</td>
</tr>
</tbody>
</table>
revealed that intraoperative infusion volumes possess a statistically significant impact onto the early postoperative general morbidity (tab. 5). The mean infusion volume in patients with complications was 10.4 mL/kg b.w./h, whereas in patients with no complications, this volume was only 12.6 mL/kg b.w./h (mean) (tab. 3 and 4). Using multivariate analysis, an increased risk for the occurrence of general complications was found for the 3 following parameters:
- group of age (≥ 65 years) (p<0.001),
- BMI (p=0.025), and
- preoperative occurrence of pulmonary accompanying disease, in particular, restrictive disturbance of ventilation (p=0.030).

There was no impact by intraoperative infusion volume, treatment with catecholamines and administration of blood products.

The general complication rate of 20% has not changed over the study period.

### Hospital lethality

Prior to discharge from the hospital, 4 patients died (hospital lethality, 2.8%). A multiple analysis of factors and parameters having an impact was not reasonable due to the low number of patients who died. From the tumor group of patients, 3 individuals died (2.9%), out of the pancreatitis group 1 patient (2.4%).

### Hospital stay

Hospital stay, postoperative stay and stay on the ICU showed uncharacteristic variations during the investigation period with no clear trend (fig. 6). An impact of fast-track elements were not detectable.

### DISCUSSION

Advantages of the fast-track concept can be put into effect in surgical interventions of the rather smaller and middle extent, in particular, in elective colonic resections, they are well documented (1, 2, 3). In complex surgical interventions such as pancreatic resections associated with higher postoperative complication and lethality rates, there are only a few

<table>
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<tr>
<th>Table 4. Impact of perioperative measures onto the early postoperative specific morbidity (univariate analysis)</th>
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<tbody>
<tr>
<td><strong>Wartość p / p value</strong></td>
</tr>
<tr>
<td>Intraoperative infusion (mL/kg b.w./h)</td>
</tr>
<tr>
<td>Intraoperative transfusion</td>
</tr>
<tr>
<td>Intraoperative transfusion FFP</td>
</tr>
<tr>
<td>Administration of catecholamines intraoperatively</td>
</tr>
<tr>
<td>Use of a thoracic PDC</td>
</tr>
<tr>
<td>Postoperative artificial respiration &lt;6 h</td>
</tr>
<tr>
<td>Initiation of postoperative heparin administration</td>
</tr>
</tbody>
</table>

ml/ kg m.c./h = milliliter per kilogramm body weight per hour
FFP = fresh frozen plasma
PDC = peridural catheter

<table>
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<tr>
<th>Table 5. Impact of perioperative measures onto the early postoperative general morbidity (univariate analysis)</th>
</tr>
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<tbody>
<tr>
<td><strong>p</strong></td>
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<tr>
<td>Intraoperative infusion (mL/kg KG/h)</td>
</tr>
<tr>
<td>Intraoperative transfusion</td>
</tr>
<tr>
<td>Intraoperative transfusion – FFP</td>
</tr>
<tr>
<td>Intraoperative administration catecholamines</td>
</tr>
<tr>
<td>Einsatz eines thorakalen PDK</td>
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<tr>
<td>Postoperative artificial respiration &lt;6 h</td>
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<tr>
<td>Initiation of postoperative heparin administration</td>
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ml/ kg m.c./h = milliliter per kilogramm body weight per hour
FFP = fresh frozen plasma
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data available showing a positive effect on the overall result (4, 5). Kehlet (6) demands justifiably that specific intervention-related studies on this issue needs to be inaugurated and conducted since each operation is characterized by a specific perioperative pathophysiology and risk.

Therefore, the presented study aimed for the assessment of the value of fast-track-concept elements in a standardized surgical intervention, the classical Kausch-Whipple procedure (partial duodenopancreatectomy). During the 10-year study period, a considerable number of elements has been established resulting in the problem that the effect assessment of a single element onto morbidity and lethality rate is substantially aggravated. Therefore, it appeared reasonable to focus the study onto the following components:
- changes of the intraoperative infusion therapy,
- differences in the catecholamine therapy,
- changes of the transfusion therapy,
- modification of the perioperative analgesia.

There is a controversial discussion in the literature related to volume and type of intraoperatively used infusion in various surgical interventions of different extent. While numerous abdominal surgeons favor rather a restrictive fluid regimen (7-10), the anesthesiologists argue for a more liberal intraoperative infusion regimen (11, 12). With regard to the intraoperative infusion regimen and catecholamine therapy in pancreatic resections, there are only a few data available (tab. 6, 7). Nisanevich et al. (10) have found by means of a prospective, randomized study in extended abdominonasurgical interventions and rather liberal administration of fluids (10 mL/kg b.w. as bolus + 12 mL/kg b.w./h) a slightly increased complication rate versus a restrictive regimen (no bolus + 4 mL/kg b.w./h). Kox and Spies recommended for pancreatic surgical interventions including approximately 500 mL/h solution of full electrolytes a rather low dosage (13). The best conclusion can be derived by comparison of results of the presented study with those obtained by Lindenblatt’s working group in Rostock (Germany), which analyzed 98 patients with pancreatic head resections (including also left and segmental pancreatic resections) in its retrospective study. The mean infusion volumes were lower in the own group of patients (pancreatic head resections only) (tab. 6).

Using subgroup analysis, Lindenblatt et al. did not report any significant differences with regard to postoperative specific morbidity and lethality in patients with an intraoperative administration of a fluid volume of < 10, > 10 to < 15 and > 15 mL/kg b.w./h. Using univari-

<table>
<thead>
<tr>
<th>Author</th>
<th>Study period</th>
<th>(n)</th>
<th>Mean absolute</th>
<th>Means (mL/kg b.w./h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lindenblatt et al. (5)</td>
<td>2003-2005</td>
<td>98a</td>
<td>6312 ml</td>
<td>13,9 ± 0,9</td>
</tr>
<tr>
<td>Own results</td>
<td>1997-2006</td>
<td>143</td>
<td>3784 ml</td>
<td>12,2 ± 4,2</td>
</tr>
</tbody>
</table>

a) Pancreatic segmental resections, pancreatic left resections, partial duodenopancreatectomies – among them 32 Kausch-Whipple procedures
ml/ kg m.c./h = milliliter per kilogramm body weight per hour

<table>
<thead>
<tr>
<th>Author</th>
<th>Study period</th>
<th>(n)</th>
<th>Patients with administration of catecholamines noradrenalinelines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lindenblatt et al. (5)</td>
<td>2003-2005</td>
<td>98a</td>
<td>74% 54%</td>
</tr>
<tr>
<td>Own results</td>
<td>1997-2006</td>
<td>143</td>
<td>61,4% 26,4%</td>
</tr>
</tbody>
</table>

a) Pancreatic segmental resections, pancreatic left resections, partial duodenopancreatectomies – among them 32 Kausch-Whipple procedures
ate analysis of the own results, there is also no significant difference of the early postoperative specific morbidity depending on the infusion volume. However, in the same analysis considering early postoperative general morbidity, there were some very interesting differences: Patients with general complications received intraoperatively significantly less infusion volume on average (10.4 mL/kg b.w./h) than those subjects with no complications (12.6 mL/kg b.w./h). A more liberal intraoperative infusion therapy (12.6 mL/kg b.w./h) appears to have the potential to lower the number of general complications. The comparatively lower infusion rate on average in the presented study was not masked by an increased percentage of catecholamine use – in comparison to Lindenblatt et al., there is even a slightly lower percentage of patients with intraoperative administration of catecholamines considering all patients needing catecholamines as well as considering separately the use of noradrenaline (tab. 7). An alternative explanation for the higher general complication rate associated with lower infusion rates might be seen in the intended lower infusion rate in patients with accompanying cardiopulmonary diseases.

In consensus with other authors, the problem how to manage fluid volume and catecholamine therapy needs to be solved individually in each patient. Several authors recommend, therefore, an extended intraoperative cardiopulmonary and -circulatory monitoring (14). This measure can be helpful in risk patients, however, it is difficult to take such monitoring into action in clinical routine and daily practice. The following strategy appears to be the basis for an immediate stabilization of the single patient providing a low early postoperative overall morbidity and lethality to:

- take care, primarily, for a fluid balance avoiding hypo- and hypervolemia (15),
- include colloids in the management of infusion therapy (16),
- exclude possibly excessive and/or long-term application of catecholamines (5), and
- use catecholamines such as dobutamine (17) and/or noradrenaline (5).

Over the study period, there was a significant reduction of the intraoperative and (as trend) the total (perioperative) transfusion volume of red cell packs, which could be derived from the lower number of patients needing transfusion as well as the number of transfused red cell packs. One cause seems to be the novel transfusion guidelines (18), which are based mainly on the results of a multicenter randomized controlled study by Hébert et al. (19) revealing that there are no disadvantageous effects by a rather restrictive indication for a transfusion but even an advantageous effect can be seen in healthy patients and only in older patients with accompanying cardiopulmonary diseases, a more liberal indication for transfusion can be recommended.

Multimodal treatment concepts for analgesia is the key element to

- minimize postoperative pain,
- reduce opiate-associated organ dysfunctions, and
- improve the postoperative recovery

for a successful fast-track surgery due to utilization of synergisms (20). In this context, thoracic peridural anesthesia is greatly suitable for more complex surgical interventions, in particular, within the upper abdomen (21, 22). After 2000, application of ropivacain / sufentanil via the thoracic peridural catheter combined with intravenous application of metiamizol has increasingly displaced the application of piritramide via PCA pump as standard analgetic procedure, which has led (from a personal point of clinical view) to an improved effect of the analgetic management as well as to a shortage of postoperative gastric atonia in the patient cohort of the presented study. In patients with analgetic management via thoracic peridural catheter, it was possible to allow tea earlier during the postoperative course than in patients with a PCA pump (tab. 1, 2) which is in accordance with the literature (23, 24). The mean time until the first postoperative administration of tea in the presented patient cohort depending on the clinical status and the appropriate decline of pancreatic enzymes within the serum (normally on the 2nd postoperative day) is comparable with reports of other authors: 4-5 d (25), 4 d (26). Whether in the majority of cases favorable experiences with regard to an early postoperative initiation of enteral feeding in various other surgical diseases also apply for partial duodenopancreactectomy, has not been definitively decided yet, though Berberat et al. recommend this as in pancreatic surgery (4).
An earlier bowel function postoperatively as observed by other authors in case of early nutrition and mobilization (27, 28) could not be detected in the own patient cohort.

However, there was also a trend but not a significant shortage of the postoperative respiration time in case of a thoracic periodical catheter. Interestingly, this was not associated with a reduction of postoperative morbidity as also reported by other study groups (29, 30).

CONCLUSIONS

In conclusion, a distinct benefit by fast-track elements in complex surgical interventions such as pancreatic head resections can only be partially detected. Despite uni- and multivariate analysis, a reliable result with regard to the impact of single factors and measures on the overall surgical outcome is almost not possible. A low hospital lethality after such complex surgical interventions is mainly caused by high surgical competence and expertise. In addition, this implies that a lack of surgical quality can not be balanced by fast-track concepts or their single elements alone. Modern general anesthesia with individual intraoperative restriction of fluid volume, a critical use of “vasopressors” (catecholamines) and a multimodal perioperative analgetic concept can influence the known high postoperative morbidities in a moderate percentage.

REFERENCES