



Early combined parenteral and enteral nutrition for pancreaticoduodenectomy – Retrospective cohort analysis



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HIGHLIGHTS

- ECPEN is one possible nutritional technique after pancreaticoduodenectomy.
- The coverage of caloric requirements per patient was 93.4%.
- The coverage was higher in patients with needle catheter jejunostomy.
- With ECPEN malnutrition or immunonutrition did not affect outcomes.

ARTICLE INFO

Article history:

Received 4 January 2016

Received in revised form

2 February 2016

Accepted 2 February 2016

Keywords:

Pancreatic surgery

Clinical nutrition

Pancreaticoduodenectomy

Early combined enteral and parenteral nutrition

ABSTRACT

Background: Suggested guidelines for nutritional support after pancreaticoduodenectomy are still controversial. Recent evidence suggests that combining enteral nutrition (EN) with parenteral nutrition (PN) improves outcome. For ten years, patients have been treated with Early Combined Parenteral and Enteral Nutrition (ECPEN) after PD. The aim of this study was to report on rationale, safety, effectiveness and outcome associated with this method.

Methods: Consecutive PD performed between 2003 and 2012 were analyzed retrospectively. Early EN and PN was standardized and started immediately after surgery. EN was increased to 40 ml/h (1 kcal/ml) over 24 h, while PN was supplemented based on a daily energy target of 25 kcal/kg. Standard enteral and parenteral products were used.

Results: Sixty-nine patients were nutritionally supplemented according to ECPEN. The median coverage of kcal per patients related to the total caloric requirements during the entire hospitalization (nutrition balance) was 93.4% (range: 100%–69.3%). The nutritional balance in patients with needle catheter jejunostomy (NCJ) was significantly higher than in the group with nasojejun tube (97.1% vs. 91.6%; $p < 0.0001$). Mortality rate was 5.8%, while major complications (Clavien-Dindo 3–5) occurred in 21.7% of patients. Neither the presence of preoperative malnutrition nor the application of preoperative immunonutrition was associated with postoperative clinical outcome.

Conclusion: This is the first European study of ECPEN after PD. ECPEN is safe and, especially in combination with NCJ, provides comprehensive coverage of caloric requirements during the postoperative

Abbreviations: ABW, adjusted body weight; ASA, American Society of Anesthesiology; ASPEN, American Society for Parenteral and Enteral Nutrition; BMI, body mass index; CVC, central venous catheter; DGE, delayed gastric emptying; DGEM, German Society for Nutritional Medicine; ERAS, Enhanced recovery after surgery; ECPEN, early combined parenteral and enteral nutrition; ICU, intensive care unit; IBW, ideal body weight; NCJ, Needle catheter jejunostomy; NRS, nutritional risk screening; PD, Pancreaticoduodenectomy; POPF, postoperative pancreatic fistula; RCT, randomized controlled trial.

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<http://dx.doi.org/10.1016/j.amsu.2016.02.002>

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phase. Clinical controlled trials are needed to investigate potential benefits of complete energy supplementation during the early postoperative phase after PD.

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1. Introduction

Pancreaticoduodenectomy (PD) is the only potential curative approach to treat premalignant and malignant neoplasms of the pancreatic head [1,2]. Although the surgical procedure is widely standardized, guidelines about postoperative nutrition differ throughout the world. While the American Society for Parenteral and Enteral Nutrition (ASPEN) does not recommend any nutritional support when sufficient oral intake can be resumed within 7–10 days [3], the Society for Enhanced Recovery after Surgery (ERAS) suggests early oral intake (starting at the first day after surgery), which should be carefully increased over 3–4 days after pancreaticoduodenectomy [4]. As a further option, the German Society for Nutritional Medicine (DGEM) recently published guidelines based on a consensus which included experts from national nutritional societies from Switzerland and Austria. The DGEM recommends a supplementation with parenteral feeding, if less than 60% of daily caloric requirements can be achieved orally or enterally within 4 days [5].

In general, beneficial effects of postoperative oral or enteral nutrition (EN) compared to the parenteral route on energy intake in surgical patients are widely accepted [5]. However, delayed gastric emptying (up to 57%) and/or intestinal paralysis may lead to insufficient postoperative caloric intake, particularly after PD [6]. In order to compensate for deficiencies in postoperative caloric intake, the relevance of the application of additional parenteral nutrition (PN) as well as the impact of different routes of enteral supplementation (nasojejun tube or needle catheter jejunostomy (NCJ)) remain unclear.

A recent randomized controlled trial has shown that additional PN is safe and effective in critically ill patients in the intensive care unit (ICU) [7]. Focusing on patient collectives after PD, a few Asian studies confirmed beneficial effects of combined postoperative EN and PN as compared to either enteral [8] or parenteral [9] nutrition alone. Furthermore, a systemic review conducted in 2013 comparing five feeding routes after PD (oral, nasojejun tube, gastrojejunostomy tube, NCJ, and PN) favored oral postoperative feeding. However authors did exclude studies with combined PN and EN [10].

The primary objective of the present study was to analyze safety and effectiveness of early combined parenteral and enteral nutrition (ECPEN) after PD, and secondarily to assess the impact of different enteral routes (nasojejun tube versus NCJ) on total caloric intake and outcome.

2. Material and methods

This is a retrospective single cohort analysis. Consecutive patients receiving standardized ECPEN after PD were included in this retrospective outcome analysis. Patients with different nutritional regimens other than ECPEN were excluded. Operations were performed between 2003 and 2012 by three senior surgeons. This study was approved by the local ethics committee (KEK-ZH-Nr. 2013-0079) and is registered on [researchregistry.com](http://www.researchregistry.com) (researchregistry826).

2.1. Pre- and intraoperative standards

Pre- and intraoperative procedures were standardized among all included patients. Somatostatin was used in presence of a soft texture of the pancreas. Prior to 2007 patients did not receive any nutritional supplements before surgery. Since 2008 preoperative immunonutrition (including Omega 3 fatty acids, nucleotides and arginine) was applied routinely. Pylorus preserving PD followed by placement of a feeding tube was performed in all of the patients. The anastomosis of the pancreas was carried out as end to side pancreatojejunostomy with resorbable suture material.

2.2. Postoperative early combined parenteral and enteral nutrition (ECPEN)

ECPEN was started immediately after transfer to the ICU. EN started with 20 ml/h (1 kcal/ml) and was increased by 5 ml/h every six hours to a maximum of 40 ml/h. Additionally, PN was supplemented to cover total daily caloric requirement.

Daily caloric requirement was defined as 25 kcal/kg of ideal body weight (IBW; Males: $IBW (kg) = 50.0 kg + 2.3 kg$ for every 2.54 cm taller than 152.4 cm; Females: $IBW (kg) = 45.5 kg + 2.3 kg$ for every 2.54 cm taller than 152.4 cm) [11,12]. If the actual body weight was >30% greater than the IBW, adjusted body weight (ABW; $ABW (kg) = IBW + 0.4 \times (actual\ weight - IBW)$) was used to calculate daily caloric needs [13]. From 2003 to 2008, EN was applied via a nasojejun tube; between 2009 and 2012, a NCJ was placed into the jejunum 20 cm from the Treitz ligament. PN was applied via a central venous catheter (CVC). For both EN and PN, standardized products with supplements of vitamins, minerals, and trace elements were used, covering daily requirements. No immunonutrition was used postoperatively.

Oral fluid intake after PD was initiated at the earliest 6 h after surgery depending on the occurrence of nausea, awareness and pain. Oral food intake was started, if bowel sounds were detectable. Further increase of food intake was based on gastrointestinal function.

Nursing personnel documented daily amounts of caloric intake by oral, enteral, and parenteral routes. As soon as the oral intake of calories increased, PN and then EN were decreased, respecting the total daily requirements of calories (25 kcal/kg of IBW or ABW per day) during the whole hospitalization [11]. The caloric value of oral intake was calculated based on nutritional standards of the institution (fluid nutrition between 675 kcal/d and 1150 kcal/d, stuffed nutrition 1000 kcal/d, solid nutrition 1700 kcal/d).

A control of serum glucose concentration (target serum glucose < 8 mmol/l) was granted to prevent hyperglycemia [14]. Patients were transferred to the ward as soon as they were considered to be hemodynamically stable and fit enough for off bed physiotherapy. Subsequently, daily medical consultation and nutrition counseling were performed. In case of chylous ascites, EN was stopped for a minimum of 3 days and replaced by total PN [15].

2.3. Outcome parameters

The primary outcome parameter was the caloric intake by ECPEN. Therefore, the nutritional balance representing the

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