

Paraplegia Following Intraoperative Celiac Plexus Injection

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The technique for percutaneous and open neurolytic celiac plexus injection, using ethanol or phenol, for relief of intractable pancreatic cancer pain has been well described. Prospective randomized studies, demonstrating safety and efficacy with few complications, have led to widespread acceptance and use of this palliative procedure. The complications of neurolytic celiac plexus injection are rare, and are usually minor. However, transient or permanent paraplegia has been reported previously in 10 cases. The case described herein represents the third reported case of permanent paraplegia following open intraoperative neurolytic celiac plexus injection using 50% ethanol. The literature surveying the indications for this procedure, routes of administration, known complications, and their pathophysiology are reviewed. (*J GASTROINTEST SURG* 1999; 3:668-671.)

KEY WORDS: Celiac plexus injection, chemical splanchnicectomy, pancreatic cancer, cancer pain, paraplegia

Neurolytic celiac plexus injection (NCPI) for palliation of pain in patients with unresectable pancreatic cancer was first described by Copping et al.¹ Open and percutaneous approaches to NCPI were developed and gained increasing support as this technique was perfected for the treatment of patients with intractable pain resulting from pancreatic cancer.² A number of studies,³⁻⁵ including a prospective randomized trial,⁶ established the safety and efficacy of the procedure and its ability to decrease patients' requirements for opiate analgesics and their attendant adverse side effects. The elegant study by Lillemoe et al.⁶ clearly established the ability of this procedure to improve actuarial survival for patients with unresectable pancreatic cancer.

Few complications have been reported following this procedure when it is performed in combination with exploratory laparotomy and biliary bypass, gastric bypass, or tumor biopsy. Major complications are extremely rare and usually involve transient or permanent paraplegia. The world literature reports only 10 cases of paraplegia following NCPI, eight of which involved permanent loss of motor function. Of these ten reports, only two have occurred following NCPI when performed as an open operative procedure.

Table I presents a review of the world literature of reported temporary or permanent paraplegia following percutaneous or open NCPI. To date, the existence and frequency of these complications have not been reported in the surgical literature. This article describes the third reported case of permanent paraplegia following open NCPI, in order to increase awareness of this devastating potential complication, explore its pathophysiology, and reaffirm the role of this technique of palliation in the management of patients with unresectable pancreatic cancer.

CASE REPORT

A 42-year-old woman presented to her primary care physician with painless jaundice; CT scan showed a mass in the head of the pancreas. She subsequently underwent exploratory laparotomy, and at the time of operation was judged to have an unresectable pancreatic carcinoma compressing the distal common bile duct. A cholecystojejunostomy was performed to bypass the biliary obstruction, and biopsy specimens of the pancreatic mass showed adenocarcinoma of the pancreas. Following operation, she had a 4-month symptom-free interval and was thereafter referred to our practice with progressive symptoms of gastric outlet obstruction and intractable abdominal pain radiating to the

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back and left flank. The abdominal pain was not adequately controlled with increasing dosages of oral narcotic analgesics, and these further worsened the nausea and vomiting associated with the gastric outlet obstruction. CT scans were obtained, which showed a large mass involving the head and proximal body of the pancreas, with no evidence of obvious direct or nodal metastases. It was our recommendation that she proceed with exploratory laparotomy for an attempted Whipple procedure versus a gastric bypass procedure combined with a palliative NCPI. Informed consent was obtained for the above-mentioned procedures, following a detailed discussion of the relative risks of complications usually associated with the recommended operative procedures.

The patient subsequently underwent exploratory laparotomy, which revealed a sizable pancreatic mass that was firmly fixed to the retroperitoneum and encased the superior mesenteric vein. The tumor mass partially compressed the proximal duodenum, and a gastrojejunostomy was cre-

ated to bypass the gastric outlet obstruction. NCPI was performed using the technique described by Lillemoe et al,⁶ which employed a total volume of 50 ml of 50% ethanol divided equally between the left and right para-aortic regions adjacent to the takeoff of the celiac artery. The gastric bypass, NCPI, and remainder of the operation proceeded without difficulty, and following extubation the patient was transferred to the recovery room in stable condition.

Approximately 6 hours postoperatively the patient was alert and conversant, stating that her preoperative back and flank pain was entirely relieved. However, her bilateral lower extremities were noted to be flaccid and areflexic. Careful neurologic examination revealed loss of movement, pinprick, and temperature sensation below the T10 level, while light touch and proprioception were preserved. Emergent MRI was obtained and revealed images consistent with anterior spinal cord ischemia and infarction at the T9-10 level (Fig. 1). The anterior spinal artery was noted to be intact (Fig. 2) at levels superior to the T9-10 lesion

Table I. Previous reported cases of temporary or permanent paralysis following celiac plexus neurolytic injection

Reference	Date	Tumor type	Technique	Fluoroscopy	Neurolytic agent	Duration
Jabhal and Hunton ¹⁴	1992	Pancreatic	Percutaneous	Yes	50% ethanol 0.25% bupivacaine	Temporary
Wong and Brown ²⁰	1995	Pancreatic	Percutaneous	No	50% ethanol 0.25% bupivacaine	Temporary
Galizia and Lahiri ¹³	1974	Pancreatic	Percutaneous	No	5% phenol	Permanent
Cherry and Lambert ¹⁶	1984	Pancreatic	Percutaneous	Yes	100% ethanol	Permanent
Woodham and Hanna ¹⁵	1989	Not reported	Percutaneous	Yes	90% ethanol	Permanent
van Dongen and Crull ¹¹	1991	Colon	Percutaneous	Yes	96% ethanol 1% lidocaine	Permanent
DeConno et al. ¹⁸	1993	Pancreatic	Percutaneous	Yes	50% and 95% ethanol	Permanent
Takeda et al. ¹⁹	1996	Gastric	Percutaneous	Yes	Ethanol	Permanent
Kinoshita et al. ²¹	1996	Pancreatic	Intraoperative	N/A	Ethanol	Permanent
Iiyakawa et al. ¹⁷	1997	Gastric	Intraoperative	N/A	99.5% ethanol	Permanent
Present case	1998	Pancreatic	Intraoperative	N/A	50% ethanol	Permanent



Fig. 1. T₁-weighted MRI of the thoracic spine at the T9-10 level. This image shows anterior spinal artery ischemia with infarction seen as characteristic "H" pattern (arrow).



Fig. 2. T₂-weighted MRI of the upper thoracic spine in the same patient with anterior spinal artery ischemia and infarction. Arrow indicates flow through the anterior spinal artery of Adamkiewicz.

seen on these studies. Neurosurgical consultation was obtained, and the presumptive diagnosis was anterior spinal cord infarction secondary to spasm of the spinal artery of Adamkiewicz. Despite aggressive steroid pulse therapy during the ensuing 72 hours, the patient experienced no improvement in neurologic function following the operation. She remains pain free, and the gastric outlet obstruction symptoms have entirely resolved.

DISCUSSION

Serious complications following NCPI are rare.^{4,7} Observed complications include paresis, temporary paralysis, seizures, and temporary unconsciousness following injection with phenol, ethanol, or various local anesthetic agents.⁸ The world literature contains reports of 10 previous cases of paraplegia following NBPI, in which eight patients experienced permanent paraplegia. Only two of these eight cases occurred following NCPI performed as an open procedure combined with an abdominal operation, and the case presented in this article represents the third such case.

The etiology of this rare and devastating complication of NCPI remains uncertain. Patients in whom these symptoms develop demonstrate neurologic symptoms consistent with anterior spinal cord syndrome. This syndrome is characterized by loss of pin-

prick and temperature sensation, intact light touch sensation, complete loss of motor function, and radiographic findings consistent with ischemic injury to the anterior columns of the spinal cord. The ischemic injury to the cord is believed to follow transient or permanent reduction in flow from the anterior spinal artery of Adamkiewicz. The artery of Adamkiewicz typically originates from the aorta at the vertebral levels T9 to T11, although its origin has been variably described between T7 and L4.⁹

NCPI is performed at the level of the celiac artery, which originates from the aorta between the T12 and L1 vertebrae. The neurolytic agents preferred for NCPI—ethanol and phenol—are known to cause concentration-dependent contraction of vascular smooth muscle.¹⁰

Direct arterial injection or mechanical injury is of concern during NCPI, and most authors advocate aspiration prior to injection to ensure the absence of blood. When performing NCPI using the percutaneous approach, injecting a small amount of contrast material before the ethanol or phenol verifies that the needle tip is extravascular, but this has not eliminated the complication of paraplegia.¹¹

During injection of the celiac plexus, Hardy and Wells¹² demonstrated that injected fluid typically spreads superiorly as high as the midthoracic and cervical levels. Thus the etiology proposed for development of paraplegia is spasm or thrombosis of the anterior spinal artery of Adamkiewicz, resulting from superior spread of injected ethanol or phenol, and induced vascular smooth muscle spasm.^{11,13-19}

Direct spinal cord injection into the cerebrospinal fluid or epidural space, and hematoma have been raised as possible causes of paraplegia following NCPI. However, the selective neurologic deficits resulting from anterior spinal column injury could not be created by these potential injuries.

The risk of paralysis following NCPI is impossible to determine precisely, since the total number of procedures performed annually remains unknown. This certainly is an extremely rare complication when NCPI is performed as an open procedure by surgeons, as this report represents only the third reported case in the world literature. The existence of paraplegia following NCPI should be recognized as a potential complication by surgeons who perform this procedure. Since risk of paraplegia following this procedure is so low, there may be institutional biases as to whether to discuss this risk when obtaining informed consent. In our practice we now include discussion of the potential risk of temporary or permanent paralysis with patients who are likely to require this procedure. During this discussion we stress the extremely

low risk of this complication and emphasize the significant benefits in terms of quality of life and survival for patients who receive this treatment.

The risk of temporary or permanent paralysis following NCPI represents a catastrophic potential complication. However, it is extremely important for surgeons not to lose sight of the clear scientific data that demonstrate excellent palliation of pain, improved quality of life, and increased survival^{3,5,6,20} for patients undergoing this procedure. These benefits, and not the extremely small risk of complications, should support surgical practice to continue offering this procedure to all patients with unresectable pancreatic cancer.

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