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# Brain Death during Anesthesia Due to Undiagnosed Meningeal Carcinomatosis of Gastric Adenocarcinoma

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CEREBRAL involvement is usually a late event in advanced cancer. Leptomeningeal carcinomatosis is an uncommon form of such involvement and is usually not associated with macroscopic metastasis in the central nervous system (CNS).[1] We describe a patient with carcinoma of the stomach and previously undiagnosed leptomeningeal carcinomatosis in whom irreversible coma developed after combined general and thoracic epidural anesthesia.

## Case Report

A 52-yr-old man with a history of suspected diagnosis of pancreatic cancer was admitted for laparotomy. Before surgery he was neurologically completely healthy and head computed tomography (CT) was normal, although he was complaining of severe headache. Continuous 24-h blood pressure monitoring revealed mild arterial hypertension (145/90 mmHg). Medical therapy was initiated with diuretics and angiotensin converting enzyme inhibitor. Because of suspicion of pancreas carcinoma the patient was scheduled for exploratory laparotomy.

Anesthesia was performed as combined thoracic epidural and general anesthesia. Epidural catheter was inserted at TH 7/8 and, after a test dose of bupivacaine with adrenaline, fractional doses of a bupivacaine–sufentanil mixture were applied until analgesia from TH 4–TH 12 was achieved. A continuous infusion of 5 ml/h bupivacaine, 0.175%, with 1 μg/ml sufentanil was started. General anesthesia was induced intravenously and maintained with $O_2/N_2O$ (30/70%) and 0.6% isoflurane. Laparotomy revealed an inoperable large gastric tumor. Intraoperative course was completely uneventful with a minimum blood pressure of 100/60 mmHg, no desaturations, no hypertension, and a $Pa_{CO_2}$ in the normal range.

However, the patient did not wake up after discontinuation of the anesthetics. His pupils were widely dilated and he remained unresponsive. Neuromuscular monitoring showed no residual neuromuscular block. Central anticholinergic syndrome was excluded by applying physostigmine. The continuous epidural infusion was stopped and no liquor could be aspirated through the epidural catheter. Emergence cerebral CT was unremarkable except for some questionable basal swelling. Six hours later, after no improvement was noted, CT-angiography showed no abnormalities except narrow ventricular spaces and generalized brain edema. At this point, a lumbar puncture was performed; other than an elevated cerebrospinal fluid pressure, nothing was found. Twenty-four hours after surgery, his electroencephalogram was isoelectric and support was discontinued. Autopsy revealed a large infiltrating signet ring-cell carcinoma of the stomach and showed severe autolytic changes in the brain, particularly in the basal regions and in the cerebellum. Focal meningeal carcinomatosis of the cerebellum and Alzheimer-II-Glia cells in brainstem was found.

## Discussion

This case report of brain death during anesthesia in a cancer patient with unsuspected and undiagnosed meningeal carcinomatosis leads to two questions concerning diagnosis of cerebral affection in cancer patients and the anesthetic management in patients with potential tumor spread to the CNS.

### *Affection of the Central Nervous System*

Meningeal carcinomatosis is the spread of tumor cells throughout the meninges and ventricles. It occurs in different neoplasms: breast, lung, pancreas, stomach, prostate, colon and cholangiocarcinoma, melanoma, and lymphoma.[1–4] Headache, backache, radiculopathies, cranial nerve palsies, and dementia are principal manifestations. In gastrointestinal cancer headache, nausea, vom-

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iting, and diplopia may be the first, but rare, manifestations of meningeal carcinomatosis.[1] In contrast to parenchymatous metastasis, leptomeningeal carcinomatosis is difficult to verify. The facilities of modern diagnostic tools (CT, magnetic resonance imaging) seem to guarantee a virtual safety, which may be misleading. In the underlying case, preoperative CT of the brain showed no abnormality, therefore we did not expect any cerebral involvement and there was no reason for more sensitive and extended diagnostic procedures. However, patients with obvious carcinomatous disease complaining of recent nonspecific symptoms of elevated intracranial pressure (ICP) (severe headache, arterial hypertension, diplopia, nausea, vomiting) should be treated as if a CNS involvement was diagnosed.

*Anesthetic Management*

The anesthetic management of cancer patients in whom CNS involvement is taken into account has to respect basic principles of neuroanesthesia. Cerebral perfusion pressure should be kept at least at 60 mmHg to avoid cerebral hypoperfusion. Anesthetic drugs with minimal impact on cerebral blood flow and cerebral autoregulation should be chosen.

Even when no obvious signs of raised ICP can be found, it is possible that such patients are at the "knee" of the cerebral elastance curve. Any further increase in intracranial volume could provoke a large increase in ICP, leading to a decrease in cerebral perfusion pressure and, consequently, in hypoperfusion of the brain. Volatile anesthetics may increase ICP. Furthermore, epidural drug injection can also increase ICP.[5] It is therefore possible that if this patient had some preexisting, unrecognized abnormality of intracranial fluid dynamics, the combination of volatile anesthetics, epidural fluid injection and infusion, and a modest and unremarkable decrease in mean arterial pressure might have resulted in a critical reduction in cerebral perfusion pressure. Arterial blood pressure was consistently reduced by combining general and thoracic epidural anesthesia in a patient with preoperatively mild arterial hypertension, but was never below systolic 100 mmHg (mean arterial pressure, 70 mmHg), which is a totally acceptable blood pressure in all patients without obvious intracranial pathology. Combination of elevated ICP and reduced mean arterial pressure leading to a reduced cerebral perfusion pressure may have induced cerebral ischemia, as it has been described in experimental conditions.[6] In our patient, ischemia has to be considered as a major cause of brain edema finally leading to brain death.

Because leptomeningeal carcinomatosis is so rarely diagnosed until late in the course of a patient's disease and because so few of these patients come to the operating room, it is very difficult to make any recommendations regarding treatment in the event that a person with known disease were to present for anesthesia. At present, all that we can recommend is that the anesthesiologist should be aware of the possibility of the problems noted, understand the potential influence of various treatment choices on intracranial physiology, and attempt to plan an appropriate anesthesia.

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