Case Report

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Unforeseen Pseudotumoral Colitis in Deceased Donor with Carbon Monoxide Intoxication

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Abstract

Carbon monoxide intoxication is a well-known cause of hypoxic injury primarily to the central nervous system and myocardium, but the bowel may be also vulnerable. Patients succumbing to carbon monoxide poisoning are usually considered unsuitable for organ procurement and they are routinely rejected in many transplant centers. As the organ supply is by far insufficient to meet the needs of patients from the waiting lists for transplant, there is a greater effort to increase the donor organ pool. Therefore special attention is being devoted to such "marginal" or "high-risk "donors. Similarly, tumors revealed during organ procurement require careful consideration in the evaluation of organ donors and transplant recipients. We herein report a multiorgan procurement from a victim of carbon monoxide poisoning who underwent a prolonged cardiopulmonary resuscitation and was intraoperatively diagnosed with a right colon tumor. Intraoperative frozen section examination ruled out malignancy and revealed an acute ischemic colitis. It is suggested that patients dying of carbon monoxide poisoning who are considered appropriate donors, may have intraoperatively revealed pseudotumoral ischemic colitis which does not preclude multiorgan procurement.

Abbreviations

CO: Carbon monoxide; CO Hb: Carboxyhemoglobin; CK: Creatine Kinase

Introduction

Carbon monoxide (CO) poisoning is a paradigm of hypoxic insult, with the most susceptible tissues being the brain and heart, and with variable and non-specific clinical manifestations [1]. When resulting in brain death, it is traditionally considered as a contraindication to multiorgan procurement, because of the generalized hypoxic tissue injury. As the supply of donor organs continues to be inadequate, increasing attention is being given to extending donor criteria to include donors deceased after CO poisoning [1] and some with active, historical or unforeseen neoplasm [2]. Malignancy requires careful consideration in the evaluation of organ donors and transplant recipients both before and after transplantation [2,3]. In CO intoxication, cardiac arrhythmias may occur at CO levels ≥ 9 %. Irreversible myocardial damage from CO poisoning has been linked to elevated creatinine kinase (CK) levels. Also, an increase in the MB/ isozyme fraction with ECG abnormalities [4,5] and 20% carboxihemoglobin (CO Hb) levels have been associated with an increase of vascular permeability by endothelial lesions [4]. Beyond central nervous system hypoxic injury, irreversible myocardial injury

linked to CO intoxication and splanchnic limited or extended ischemia can increase long-term mortality in patients surviving CO poisoning [4,6,7]. Even if myocardial damage may be present in nearly 40% of poisoned individuals, the most common cause of death is anoxic brain injury [8-10]. Mesenteric ischemia may also occur following CO exposure, leading mostly to ischemic colitis [11,12]. In spite of the above concerns, solid organ procurements from CO intoxicated donors and from some having tumors, though controversial, have been reported [4,7,10]. In the present work, we illustrate a case of multiorgan procurement and transplantation from a brain death victim of CO intoxication, who also has an intraoperatively diagnosed right colon tumor. Whereas intraoperative histological criteria proved an ischemic colitis, our case suggests that hypoxia following CO intoxication can severely affect the intestine in addition to the central nervous system and heart, appearing macroscopically as a colon tumor.

Case report

A 22-year-old woman with no cardiovascular risk factor was found at home. She fainted in the bedroom where a gas heating stove was later found to have a blocked flue. The woman presented with typical pink skin pigmentation, deeply comatose and with severe central nervous system damage. The patient was in respiratory and cardiac arrest so that she required a prolonged resuscitation. She was intubated and immediately transferred to the hospital. Unfortunately, 4 hours after admission in the intensive care unit she was declared brain dead. Post anoxic encephalopathy owing to CO intoxication was

clinically diagnosed. High peak CO concentration was 24%, CO Hb level was 31%, 2 hours after removal from the bedroom.

Figure 1: Right colectomy specimen: enlargement of the colon diameter with thickening of the wall and increased consistency mimicking a tumor.

Blood pressure was 110/62 mmHg, central venous pressure was 7 mmHg. EKG was in sinus rhythm without any ischemic sign and the heart rate was 92 bpm. No gastrointestinal hemorrhage was noted. Laboratory blood tests concerning liver and renal function were normal and viral serology was negative. Plain chest X-ray and abdominal ultrasound provided normal findings.

Figure 2: Gross specimen of acute ischemic colitis showing pseudomembranes and hemorrhagic masslike appearance due to prominent submucosal edema.

The patient was given ongoing high doses of inotropic support and vasopressor drugs following the cardiac and respiratory arrest. The peak of cardiac biomarkers were CK myoglobin of 267 U/l, CK level of 406 U/l and troponin I level of 0.03 ng/dl. The prothrombin time was 17.6 sec and the INR 1.59. An observation time of 6 hours was started to certify death. The donor characteristics, blood group and somatic characteristics were suitable for some patients on the waiting list of liver, pancreas and renal transplant. Aggressive supportive care was provided. The organ procurement procedure was then decided. Abdominal surgical exploration revealed normal liver, pancreas and kidneys but a right colonic tumor of 14/11 cm was discovered above the cecum (Figures 1 and 2). No abdominal lymph node enlargement or liver or peritoneum metastases were observed.

Given these complexities, the final decision whether or not to utilize any organ in a particular circumstance was taken by a multidisciplinary team (liver-pancreas transplant surgeon, renal transplant surgeon and pathologist) after a brief discussion of the case. As a consequence, the liver, pancreas and kidneys were harvested, using deceased donor standard procurement techniques. The heart was declined by the cardiac team. At the end of the procedure, a right colectomy was undertaken (Figures 1 and 2) followed by intraoperative frozen section analysis of the resection specimen.
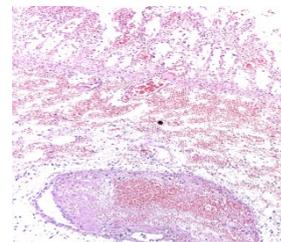

Figure 3: Acute ischemic colitis: mucosal necrosis, massive edema, congestion and hemorrhage into the lamina propria and submucosa; recent thrombosis in submucosal veins (HE, magnification x40).

Histology examination concluded within 30 min an acute ischemic colitis and ruled out malignancy (Figures 3,4 and 5). In fact, in the light of this consideration, the harvested liver, pancreas and kidneys were accepted for transplantation. The postoperative course was uneventful, either for the liver, pancreas and renal grafts recipients, with good organ performance from the very beginning.
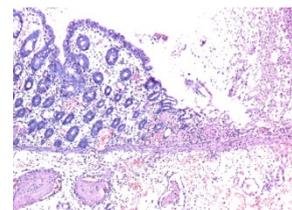

Figure 4: Acute ischemic colitis: patchy mucosal ulceration, edema, congestion and hemorrhage into the lamina propria and submucosa; recent thrombosis in submucosal veins (HE, magnification x40).

Discussion

CO poisoning is responsible for a high number of intoxication deaths in Europe and USA [5,6,9,10]. Patients dying following CO intoxication are routinely considered not suitable to organ donation because of severe hypoxic tissue injury [1,4,5]. Meanwhile, the indications for transplantation have increased and expanding the donor pool is a high priority. When tumors occur in potentially donors it is mandatory to rule out malignancy or to identify the histological type and grade of the malignancy [2,3], in order to perform the transplantation with a low risk of disease transmission from donor to recipient.

Regarding CO intoxication, tissue damage results from several mechanisms:

1. CO binds strongly to myoglobin, interfering with oxygen transportation to the mitochondria.

2. CO has a 200-fold higher affinity to hemoglobin, impairing oxygen delivery to the tissue.

3. CO shifts the normal oxygen dissociation curve to the left, further restricting oxygen delivery and producing tissue hypoxia.

4. CO may interfere with the cytochrome oxidase, leading to inhibition of cellular respiration [1,4].

The affinity of hemoglobin for CO is 200 times greater than that for oxygen. Formation of COHb interferes with oxygen transportation to cell mitochondria. Oxygen tissue delivery is further restricted due to the shift to the left of the oxygen disassociation curve [1,5,7,9,10]. The CO also inhibits cellular respiration, interfering with cytochrome oxidase system. Initial peak CO levels of potentially donors are not predictive of organ survival or failure, after transplanted [4,8,9]. Up to 90 % of organs procured from donors supported with inotropes or vasopressors, or having cardiopulmonary resuscitation prior to organ procurement, survived during follow-up [4,5,7-9]. Individual cases reported suggested that survival of patient transplanted with organs procured from carefully selected CO poisoned donors, may be comparable to that of patients transplanted with organs from non-intoxicated donors [4,5,9,10].
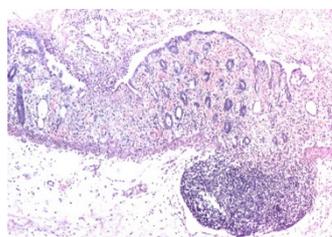

Figure 5: Acute ischemic colitis: patchy superficial mucosal necrosis covered by pseudo membranes (HE, magnification x40).

CO poisoning causes profound tissue hypoxia with an increased vascular permeability by endothelial lesions followed by tissue necrosis [4,6,7,9,10]. The most susceptible organs are the brain and myocardium but ischemic insult may also affect the bowel. Two other cases of acute intestinal ischemia following CO intoxication have been reported so far, one with fatal, massive mesenteric ischemia complicating an acute coronary syndrome with acute pulmonary edema and another with sigmoid colon ischemia and favorable course [11,12]. None had the macroscopic appearance of a localized colon tumor. Ischemic lesions of the colon entail detectable injury in the superficial part of the mucosa within one hour [12]. Further damage is observed in deeper layers in several hours (Figure 2, 3, 4). Decreased blood flow in the splanchnic organs is one of the compensatory mechanisms to maintain adequate cerebral and coronary blood flow. This consideration may explain in our case the severe but limited bowel injury due to a combined hypoxic and ischemic insult which led to severe acute ischemic colitis, as revealed by the histology. Our patient had no gastrointestinal bleeding and no negative impact on the hemodynamic status, either before or during the surgical procedure. However, given the microscopic resemblance between the ischemic acute colitis and an acute colitis with enterohaemorrhagic *Escherichia coli* O157-H7, the latter had to be excluded by bacteriological examination. Moreover, the pseudo-membranes are specific rather to a bowel infection with *Clostridium difficile* but in our case these were scarce, isolated and non-confluent.

On the other hand, the donor had a prolonged cardiopulmonary resuscitation after cardiac arrest and an uninterrupted administration of inotropic support and vasopressor drugs (about 12 hours until the organ procurement started), which worsened the ischemic damage in the splanchnic territory, despite the complete repletion with fluids. The case is uncommon due to the association between the deceased donor following CO intoxication and the concurrent severe acute ischemic colitis, appearing macroscopically as a colonic pseudotumor, as far as this has been never reported before.

Conclusion

This case should increase the awareness that ischemic injury caused by CO intoxication may also severely affect the intestine, coming to a typical macroscopic tumor aspect. Patients with brain death following CO poisoning should be considered appropriate multiorgan donors provided they can be given aggressive supportive care until the decision about organ transplantation is finalized. High peak CO-level, inotrope/vasopressor use, or cardiopulmonary resuscitation prior to procurement is not a contraindication for organ harvesting and transplantation. Tumors revealed during procurement procedure should be carefully and promptly assessed by a multidisciplinary medical team, allowing the decision whether or not to utilize any organ to be taken.

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