

Efficacy of CO₂-DSA in embolization

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Abstract. Intra-arterial digital subtraction angiography using CO₂ (CO₂-IA-DSA) is effective for detecting arteriovenous and arteriportal shunts in the liver. We carried out CO₂-IA-DSA in addition to selective arteriography using a iodinated contrast medium in 31 patients with unresectable hepatocellular carcinoma (HCC). As a result, CO₂-IA-DSA detected an AV shunt in 4/31 patients and an AP shunt in 16/31 patients for a total of 20 cases of shunt, whereas conventional hepatic IA-DSA detected only AP (AV shunt) shunts in 3/31 patients. For HCC without any shunt, Gelfoam embolization was carried out after injection of Lipiodol and Farmorubicin (FARM). In patients with an AP shunt, injection of Lipiodol and FARM was performed after the shunt had been embolized with Gelfoam. In patients with an AV shunt, Lipiodol and FARM were injected after the shunt had been embolized with a metallic coil. In conclusion, detection of shunts by CO₂-IA-DSA is useful for determining the optimal approach for transcatheter arterial injection.

Patients and methods

From 1991 to 1992, we tried CO₂-DSA in 31 patients with unresectable HCC, including 27 men and 4 women whose age ranged from 44 to 77 years (average, 60.1 years). Combination angiography (CO₂-DSA and conventional DSA) was performed. For CO₂-DSA, 30 ml of CO₂ obtained from a sterile filter was injected with manual pressure. For conventional IA-DSA, an iodinated contrast medium was used.

Results

Table 1 shows the detection rate of AV (AP) shunts by conventional angiography and CO₂-DSA. Conventional hepatic angiograms revealed only 9.6% of shunts, whereas CO₂-DSA demonstrated 65% of shunts. Figure 1 (left side) shows an HCC that was found in segment 4 by conventional angiography with iodinated contrast medium. This angiography shows no shunt. On the right side is the result of CO₂-DSA. It reveals the hepatic vein in the hepatic arterial phase. This indicates an AV shunt.

Figure 2 (left side) shows the hepatic arteriogram obtained with a conventional contrast medium. Tortuous tumor vessels and intrahepatic small arteries can be clearly seen. On the right is the CO₂-DSA image. This does not show the small branches of the intrahepatic artery that were seen with conventional angiography, but an AP shunt is clearly demonstrated.

Discussion

In the present study, we evaluated the efficacy of CO₂-IA-DSA in embolization of HCC. It is well known that several prognostic factors of HCC depend upon tumor extension, especially the tumor volume and intraportal tumor infiltration. A minor AP (AV) shunt in a tumor causes intrahepatic metastasis. We found that CO₂-IA-DSA would be the best technique for the detection of AV or AP shunts in HCC. In CO₂-IA-DSA, small branches of the intrahepatic artery in HCC are not shown, but conventional IA-DSA shows tumor vessels and small arteries.

Table 1. Detection rate of AP (AV) shunt in angiography

Contrast medium	Arteriportal shunt
Iodinated (conventional)	3/31 (9.6%)
CO ₂	21/31 (65%) ^a

^a In 4 cases an AV shunt was detected

Work presented at the Third International Symposium on Treatment of Liver Cancer, Seoul, Korea, 12–13 February 1993

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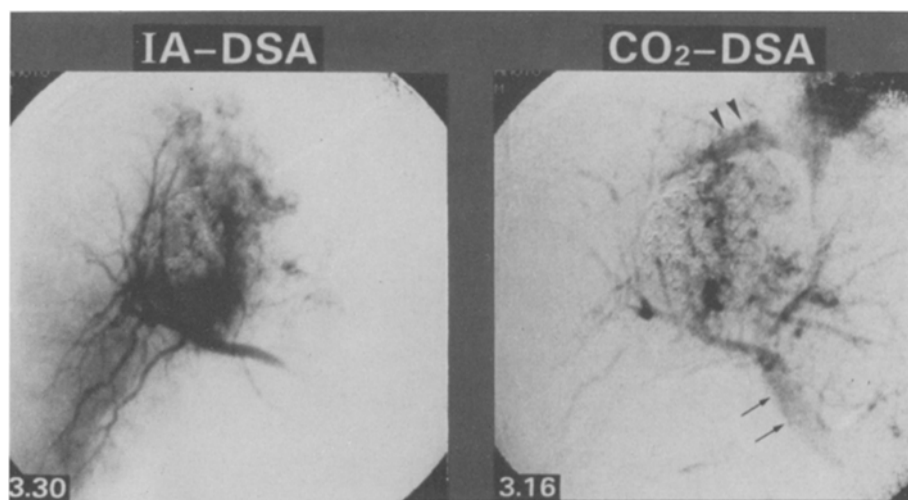


Fig. 1. *Left side* Arteriogram of HCC with conventional iodinated contrast medium
Right side CO₂-DSA shows an AV shunt and an AP shunt

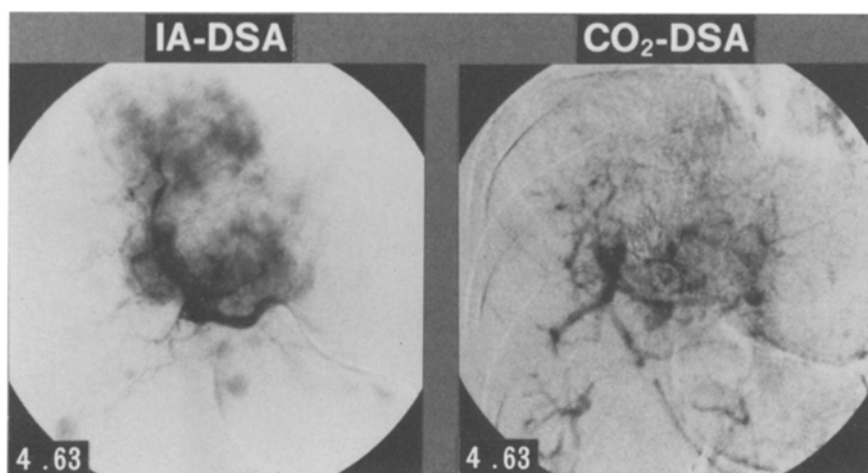


Fig. 2. *Left side* Arteriogram of HCC with conventional iodinated contrast medium.
A hypervascular nodule area is visible
Right side CO₂-DSA shows an AP shunt

Oppenheimer and Durant [3] believe that CO₂ bubbles block the capillary bed. However, the capillary block they observed was transient and caused no significant problem because the solubility of CO₂ resulted in very rapid absorption [3]. However, recent experience with arterially injected CO₂ (proper hepatic injection) has demonstrated poor perfusion of the distal arteries with reflux into the abdominal aorta. This phenomenon is a result of the buoyancy of the gas [2].

The existence of potential communication between the hepatic artery and the portal vein has been known for over a century [1]. This route of flow has classically been considered to be a transsinusoidal shunt. Recently, a transvasal route has been recognized [4]. Transvasal AP shunting demonstrates early shunting into the portal vein. In contrast, transsinusoidal shunting shows retrograde opacification of the portal vein. The transvasal route occurs in the case of HCC, metastasis, and many other conditions. We

suspect that CO₂ bubbles can fill this transvasal shunt in HCC.

If an AP or AV shunt is detected, proper selection of the method of transcatheter arterial embolization (TAE) is necessary since this will make TAE more effective and safe.

References

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