SHORT COMMUNICATION

Use of the triaxial microcatheter method in super-selective transcatheter arterial chemoembolisation for hepatocellular carcinoma

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Objectives: Transcatheter arterial chemoembolisation (TACE) has been widely used for inoperable hepatocellular carcinoma (HCC). Super-selective TACE is preferable to non-selective therapy, because it maximises the impact of treatment on the tumour while minimising damage to tumour-free liver parenchyma. It is therefore important to advance the catheter tip as close as possible in the feeding artery. There is now a new microcatheter with a 1.9-Fr tip with no taper, which can be inserted into a 2.7-Fr microcatheter. In this study we describe the new technique of using the two microcatheters called the triaxial microcatheter method.

Methods: We evaluated 30 TACE procedures to investigate whether or not the catheter tip could be advanced closer to HCC with the triaxial microcatheter method than with previous TACE using a conventional microcatheter.

Results: With conventional microcatheters, the level of embolisation was a lobar artery in 4 cases, segmental in 8 cases, subsegmental in 15 cases and sub-subsegmental in only 1 case. TACE could not be performed in two cases. When using the triaxial microcatheter method the level of embolisation was subsegmental in 8 cases, including 2 in which the level was the same as that with a conventional microcatheter, sub-subsegmental in 13 cases and more distal in 7 cases. In the two cases in which TACE could not be performed with the conventional microcatheter, it could be performed sufficiently using the new method. As a whole, in 28 of the 30 procedures (93%) we could successfully advance a catheter tip closer than with the previous TACE.

Conclusion: The triaxial microcatheter method appears to be useful.

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Hepatocellular carcinoma (HCC) is the most common primary neoplasm of the liver [1]. The incidence of HCC is particularly high in South East Asia and sub-Saharan Africa, but there is a clear rise in the incidence in Western Europe and the United States [2].

Transcatheter arterial chemoembolisation (TACE) has been widely used in cases of HCC during the past 15 years. Digital subtraction angiography and advanced catheter technology have enabled super-selective catheterisation of the arterial branches feeding the tumour, particularly microcatheters in which the appearance of the microcatheter has contributed largely to this. Selective TACE is preferable to non-selective therapy because a selective approach maximises the impact of treatment on the tumour while decreasing collateral

damage to tumour-free liver parenchyma [3–5]. Therefore, it is necessary to advance the catheter tip to the tumour as close as possible in the feeding artery. However, sometimes this may be difficult owing to vessel tortuosity or shape of the bifurcation and may result in sagging of the microcatheter or distal catheter displacement beyond the desired vessel ostium.

There is now a new microcatheter available that has a 1.9-Fr tip with no taper. It can be inserted into a 2.7-Fr microcatheter, which has a large inner diameter and is usually used when a better quality angiogram is desired. We hypothesised that by using a 1.9-Fr no-taper microcatheter and 2.7-Fr microcatheter it should be possible to advance the catheter closer to the HCC. We thought the 2.7-Fr microcatheter would give a more stable position for the advancement of the 1.9-Fr no-taper microcatheter into the feeding artery. In this article we describe this new technique as the triaxial microcatheter method.

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Figure 1. The triaxial microcatheter system consists of a 1.9-Fr microcatheter (small arrow), a 2.7-Fr microcatheter (large arrow), a 4-Fr catheter (small arrow head) and a 4-Fr sheath (large arrow head).

Methods and materials

Between September 2008 and February 2009, super-selective TACE for HCC was performed with the triaxial microcatheter method in 27 patients who had previously undergone TACE with a conventional microcatheter, but a selective position into the feeding artery had not been achieved. Approval was obtained to use this technique by the institutional review board and informed consent was obtained from all patients.

The 27 patients consisted of 22 men and 5 women, with a mean age of 70 years (range, 54–83 years). All of them were inpatients at the hospital. Three patients had two HCCs to be treated by TACE, therefore, the total number of evaluated TACE procedures was 30. We evaluated these 30 procedures and assessed whether or not the catheter tip could be advanced closer to HCC with the triaxial microcatheter method compared with using a conventional microcatheter. All TACE was performed by a single operator (MS) and approached via the right femoral artery. The same 4-Fr sheath and 4-Fr catheter were used and were advanced to the same position as the previous TACE: the coeliac artery in 20 procedures, the common hepatic artery in 5 procedures, the proper hepatic artery in 3 procedures, the gastroduodenal artery (GDA) in 1 procedure and the right renal artery in 1 procedure. A 4-Fr sheath 11 cm in length

was used in 27 procedures and a 4-Fr sheath 25 cm in length was used in 3 procedures. The 4-Fr catheters were shepherd hook (SHK) catheters (Clinical Supply, Hashima, Japan) in 26 procedures, the Rosch hepatic (RH) catheter (Clinical Supply) in 2 procedures and a modified cobra-type catheter (Clinical Supply) in 2 procedures. The conventional microcatheters were a 1.8-Fr distal, 2.7-Fr proximal microcatheter (PIXIE; Tokai Medical, Kasugai, Japan) in 21 procedures and a 2.0-Fr distal, 2.9-Fr proximal microcatheter (Sniper 2 Selective Revolution; Clinical Supply) in 9 procedures. In all the triaxial microcatheter method procedures, a 1.9-Fr distal, 1.9-Fr proximal microcatheter (small microcatheter; MARVEL; Tokai Medical) and a 2.7-Fr distal, 2.9-Fr proximal microcatheter (large microcatheter; Sniper 2 High-Flow; Clinical Supply) (Figure 1) were used. A 0.014-inch, 180-cm microguidewire (BEGIN; SOLUTION, Yokohama, Japan) was used in all examinations. The tip of the large microcatheter was reshaped by using a drier to approximately a 45–90° angle in all examinations. In all TACE an emulsion of chemotherapeutic agents (mitoxantrone in 18 procedures, epirubicin in 7 procedures, zinostatin stimalamer in 3 procedures, cisplatin in 1 procedure and Gelfoam particles in 1 procedure) in iodised oil and/or Gelfoam particles was used.

Results

The levels of TACE are summarised in Table 1. 28 tumours were fed by a branch of the hepatic artery and 2 were fed by a branch of the GDA or the right renal artery.

At previous TACE using conventional microcatheters, the level of embolisation was the lobar artery in 4 cases (13%), segmental artery in 8 cases (27%), subsegmental artery in 15 cases (50%) and sub-subsegmental artery in 1 case (3%). In 2 cases (7%) TACE could not be performed because the tumour was fed by a branch of the GDA or the right renal artery, which could not be selected.

When using the triaxial microcatheter method, the level of embolisation was subsegmental artery in 8 cases (27%), including 2 cases in which the level was the same as that with a conventional microcatheter, sub-subsegmental artery in 13 cases (43%) (Figure 2) and a more distal artery in 7 cases (23%). In 2 cases (7%) in which TACE could not be performed with the conventional microcatheter it could be performed sufficiently at branches of the GDA or the right renal artery (Figure 3).

Table 1. Level of transcatheter arterial chemoembolisation (TACE) using a conventional microcatheter and triaxial microcatheter method

		Conventional microcatheter (%)	Triaxial microcatheter method (%)
Level of embolisation	Lobar	4 (13)	0 (0)
	Segmental	8 (27)	0 (0)
	Subsegmental	15 (50)	8* (27)
	Sub-subsegmental	1 (3)	13 (43)
	More distal	0 (0)	7 (23)
	Other	0 (0)	2** (7)
Embolisation failure		2** (7)	0 (0)
Total		30	30

*Include 2 cases in which the level of embolisation was the same as with a conventional microcatheter.

**Levels in these 2 cases were a branch of the gastroduodenal artery and a branch of the right renal artery, respectively.

Figure 2. A 74-year-old woman presented with hepatocellular carcinoma (HCC) in the lateral superior subsegment. (a) Contrast-enhanced CT showed enhancement of HCC at the lateral superior subsegment (arrow). (b) This HCC is fed by a branch of the lateral superior subsegmental artery (arrow). (c) At the previous transcatheter arterial chemoembolisation (TACE), a conventional microcatheter could not be inserted into the feeding artery because of sagging of the microcatheter to the right hepatic arteries (arrow). (d) When using the triaxial microcatheter method (small arrow, small microcatheter; large arrow, large microcatheter), the large microcatheter kept the position and prevented sagging so we could insert the small microcatheter into the feeding artery and perform sub-subsegmental TACE.

Figure 3. A 79-year-old man presented with hepatocellular carcinoma (HCC) in the posterior inferior subsegment. (a) Contrast-enhanced CT showed enhancement around HCC at the posterior inferior subsegment (lipiodol deposition at early phase, arrow). (b) This HCC extruded to the surface and was fed by a branch of the gastroduodenal artery (arrow). At the previously attempted transcatheter arterial chemoembolisation (TACE) we could not insert a conventional microcatheter into the feeding artery. Although a microguidewire could be inserted to the feeding artery, the microcatheter could not be advanced because it jumped to a distal position. (c) Using the triaxial microcatheter method (small arrow, small microcatheter; large arrow, large microcatheter), we could insert a small microcatheter into this feeding artery completely, advance it near the tumour and perform TACE because the large microcatheter kept its position and prevented jumping of the small microcatheter.

Overall, the microcatheter tip could be successfully advanced closer in 28 of the 30 procedures (93%) with the triaxial microcatheter method compared with previous TACE using conventional microcatheters. In only 2 cases (7%) was it advanced to the same level as the previous TACE.

Discussion

TACE is the most widely performed treatment for patients with HCC who are not eligible for curative surgery or ablation, and the efficacy has been described in numerous reports [6–9]. In 1990, Uchida et al [4] reported the efficacy of segmental TACE using a microcatheter that exerts little adverse effect on normal liver tissue and reinforces the effect of TACE for HCC. However, in 1993 Matsui et al [5] described that segmental TACE was still too invasive for small HCCs and recommended subsegmental TACE.

Recently, Kothary et al [10] evaluated the safety and efficacy of TACE in patients at high risk. They reported that the factors that determined the outcome were the extent of embolisation and the extent of replacement of liver parenchyma by the tumour. They reported that patients with non-selective lobar embolisation had a much higher mortality rate (16.6%; $p=0.03$) compared with patients who underwent selective segmental TACE (0%). It was, therefore, considered that TACE should be performed at a level as close to the HCC as possible. Namely, it is essential that a catheter tip is advanced as near the site of the feeding artery as possible.

In our study we could insert a catheter tip closer to the HCC with the triaxial microcatheter method compared with the conventional microcatheter in 28 of 30 procedures (93%). We could not advance a catheter tip beyond the level reached with a conventional microcatheter in only 2 of the 30 procedures (7%).

When using a conventional microcatheter, sometimes sagging of the microcatheter to the large artery (the splenic artery, GDA and right or left hepatic artery) occurred when it was attempted to advance the microcatheter more distally, especially in cases with tortuosity of artery. This prevented us from advancing the microcatheter. In some cases, although a microguidewire could be inserted into the feeding artery, the conventional microcatheter jumped more distally to the ostium and could not be inserted into the feeding branch. It often occurred when the angle of bifurcation of the branch was large.

Even in such cases it was easier to insert a small microcatheter into the feeding artery with the triaxial microcatheter method because the large microcatheter prevented sagging or jumping by stabilising the position. This technique is now used for all chemoembolisations that request super selective procedures in our hospital.

In conclusion, the triaxial microcatheter method appears useful for super-selective TACE. In this study, however, we are unable to discuss the prognosis of the patients owing to short follow-up periods. It is, therefore, necessary to observe them for a longer period to evaluating the clinical usefulness.

References

1. Landis SH, Murray T, Bolden S, Wingo PA. Cancer statistics, 1999. *CA Cancer J Clin* 1999;49:8–31.
2. El-Serag HB, Mason AC. Rising incidence of hepatocellular carcinoma in the United States. *N Engl J Med* 1999;340:745–50.
3. Matsuo N, Uchida H, Nishimine K, Soda S, Oshima M, Nakano H, et al. Segmental transcatheter hepatic artery chemoembolization with iodized oil for hepatocellular carcinoma: antitumour effect and influence on normal tissue. *J Vasc Interv Radiol* 1993;4:543–9.
4. Uchida H, Ohishi H, Matsuo N, Nishimine K, Ohue S, Nishimura Y, et al. Transcatheter hepatic segmental arterial embolization using lipiodol mixed with an anticancer drug and Gelfoam particles for hepatocellular carcinoma. *Cardiovasc Intervent Radiol* 1990;13:140–5.
5. Matsui O, Kadoya M, Yoshikawa J, Gabata T, Arai K, Demachi H, et al. Small hepatocellular carcinoma: treatment with subsegmental transcatheter arterial embolization. *Radiology* 1993;188:79–83.
6. Yamashita Y, Takahashi M, Koga Y, Saito R, Nanakawa S, Hatanaka Y, et al. Prognostic factors in the treatment of hepatocellular carcinoma with transcatheter arterial embolization and arterial infusion. *Cancer* 1991;67:385–91.
7. Bronowicki JP, Vetter D, Dumas F, Boudjema K, Bader R, Weiss AM, et al. Transcatheter oily chemoembolization for hepatocellular carcinoma. A 4-year study of 127 French patients. *Cancer* 1994;74:16–24.
8. Harada T, Matsuo K, Inoue T, Tamesue S, Inoue T, Nakamura H. Is preoperative hepatic arterial chemoembolization safe and effective for hepatocellular carcinoma? *Ann Surg* 1996;224:4–9.
9. Takayasu K, Arii S, Ikai I, Omata M, Okita K, Ichida T, et al. Prospective cohort study of transarterial chemoembolization for unresectable hepatocellular carcinoma in 8510 patients. *Gastroenterology* 2006;131:461–9.
10. Kothary N, Weintraub JL, Susman J, Rundback JH. Transarterial chemoembolization for primary hepatocellular carcinoma in patients at high risk. *J Vasc Interv Radiol* 2007;18:1517–26.