CT Analysis of Intratumoral Gas Formation after Hepatic Tumor Embolization

Hyun Sook Kim, M.D., In Oak Ahn, M.D., Hyung-Jin Kim, M.D., Goo Lee, M.D., Sung Hoon Chung, M.D.

Purpose: To evaluate the prevalence and the patterns of sterile gas shown at computed tomography (CT) after transarterial embolization (TAE) for primary hepatic tumor.

Materials and Methods: Among 102 patients who performed TAE for hepatoma, thirty-four in whom follow-up CT was underwent constituted the basis of our study. At CT, we evaluated the patterns and locations of intratumoral gas. We also reviewed the clinical data to exclude an infectious origin of intratumoral gas.

Results: Of 34 patients, intratumoral gas was detected in 11 patients (32%), in all of whom Gelfoam was used as an embolic material. The initial tumor size measured at pre-TAE CT was larger in patients with intratumoral gas than in patients without it (p < 0.005). No specific patterns or locations of intratumoral gas were noted on CT scans. No patients had clinical signs and symptoms that suggested infection.

Conclusion: Intratumoral gas formation without clinical evidence of infection is not an infrequent finding after TAE for hepatoma, especially when Gelfoam is used and when the tumor is large in size. This finding may be a part of postinfarction syndrome and should not be misinterpreted as a postprocedural abscess formation.

Index Words: Liver neoplasms, CT Arteries, hepatic Liver neoplasms, therapy Arteries, therapeutic blockade

INTRODUCTION

The gas could develop within infarcted tumor after the surgical ligation or transarterial embolization (TAE) of the renal or hepatic arteries (1-3). Spontaneous gas formation in proved hepatic infarcts have also been reported (4). The sterile gas within a tumor after infarction was attributed to several possible causes (1-3).

We have experienced 11 patients with intratumoral gas formation at CT after TAE of primary hepatic tumor. All of the patients did not have the clinical signs and symptoms of infection.

The purpose of this study was to evaluate the prevalence and the findings of gas shown on CT after TAE for primary hepatic tumors.

1Department of Diagnostic Radiology, College of Medicine, Gyeongsang National University
Received February 23, 1994; Accepted June 13, 1994
Address reprint requests to: In Oak Ahn, M.D., Department of Diagnostic Radiology, Gyeongsang National University Hospital, 92 Chilam-dong, Chinju 660-280. Tel. 82-591-50-8216 Fax. 82-591-758-1568

MATERIALS and METHODS

One hundred and two patients with primary hepatic tumor underwent TAE from November 1989 to June 1993. All patients underwent CT prior to TAE. Thirty-four of the 102 patients had follow-up CT with an interval of 7-33 days (mean, 15.2 days) after TAE. There were 25 men and 9 women, with ages ranging from 30 to 74 years (mean, 53 years). Twenty-six patients underwent TAE once, seven underwent twice, and one underwent TAE three times.

We used various combinations of the embolic materials during TAE: Lipiodol (ethyl ester iodized poppy seed oil, Guerbert, France), Adriamycin (II Dong Pharm. Co, Seoul), and Gelfoam (Upjohn, Kalamazoo, USA) in 16 patients, Lipiodol and Adriamycin in 16, and Gelfoam with or without mitomycin (Kyowa Hakko Kogyo Co, LTD. Tokyo, Japan) in two. Gelfoam was used as approximately 1 × 1 × 2 mm hand-made pledgets. Embolic materials were administered until the re-
flux of the contrast material was noticed.

We measured the initial tumor size in its maximal diameter at pre-TACE CT. We paid particular attention to the presence of gas within the tumor and, if present, its pattern and location were evaluated. The correlation of change of tumor size with gas formation was evaluated (chi square test). The pattern of intratumoral gas was divided into mottled, linear, pocket-like, or mixed. The location of intratumoral gas was classified into central, peripheral, or mixed, in relation to the site of Lipiodol uptake.

To exclude the infectious origin of intratumoral gas, we reviewed the patients’ charts for the presence or absence of clinical signs and symptoms of infection.

RESULTS

Of 34 patients, intratumoral gas was detected in 11 patients (32.4%), in all of whom Gelfoam was used as an embolic material.

The patterns of intratumoral gas (Fig. 1) in these 11 patients were mottled in four, mixed mottled and linear in four, mixed mottled, linear and pocket-like in two, and mixed mottled and pocket-like in one. In two patients, air-fluid levels were also noted (Fig. 2). The most frequent location of intratumoral gas was mixed central and peripheral in seven patients. In the remaining four, central and peripheral location of intratumoral gas was noted; two were central and two were peripheral.

Intratumoral gas was detected in CT obtained from 13 to 28 days after TAE. Among those patients, four underwent one or more follow-up CT, in which the gas was disappeared at 40 days after TAE in one, 3 months in one, and 4 months in two (Fig. 2). The initial tumor size before TAE was statistically significantly larger in patients with intratumoral gas (12.3 cm in average maximal diameter) than in patients without it (6.6 cm in average maximal diameter) \( (p < 0.005) \). There were no patients who had clinical signs and symptoms that suggested infection.

DISCUSSION

Transarterial chemoembolization has been widely performed for the treatment of hepatocellular carcinoma. Not infrequently, clinical signs and symptoms, such as nausea, vomiting, fever, leukocytosis, and increased SGOT and SGPT, occur after TAE, and which have been considered as postembolization syndrome (5-9). In addition, there have been several theories about the formation of gas within the infarcted tumor after TAE (1-3). Rankin (2) reported two patients in whom gas was noted after the embolization of renal cell carcinoma. He insisted that gas formation might be due to oxygen released from the tissues, particularly from trapped oxyhemoglobin. Other researchers (1) also observed the similar finding in a patient with hepatic adenoma following TAE. On the other hand, Bernardino et al. (3) postulated two causes of gas formation.
Fig. 2. Sequential CT scans of intratumoral gas after TAE.
a. CT scan before TAE shows a huge hepatoma with central necrosis in right lobe of the liver.
b. CT scan obtained 28 days after first TAE shows gas distributed both centrally and peripherally within the tumor.
c. CT scan obtained 14 days after second TAE (66 days after first TAE) shows decreased intratumoral gas. Note air-fluid level within the infarcted tumor.
d. CT scan obtained 72 days after (c) shows much diminished intratumoral gas. Air-fluid level is no longer seen.

Air introduced during the injection of particulate emboli and the release of gas secondary to tumor necrosis.

As to the pattern and location of intratumoral gas, Bernadino et al. (3) also demonstrated that the gas was both centrally and peripherally located in the tumor with linear and branching configuration. In their study, four of five patients showed the gas located distal to the high-density embolic particles at CT. In our study, however, there was no preferential pattern or location of intratumoral gas at CT and most of the patients had randomly distributed intratumoral gas.

There is no detailed description concerning the time when intratumoral gas appears for the first time and the duration it persists. Rankin (2) first noticed gas 4 days and 7 days after TAE. One of the two their cases, gas persisted for 22 days. In the studies with intrauterine fetal death, gas formation was seen as early as 55 min and as far as 16 days after fetal death (10, 11). In our study, intratumoral gas was first detected at 13 to 28 days after TAE. In four patients, it completely or nearly completely disappeared at follow-up CT scans; 40 days after TAE in one patient, 3 months after TAE in one, and 4 months after TAE in two. According to our result, the gas could persist for 4 months after TAE although it was not clear how long postinfarction gas could be present.

The use of Gelfoam as an embolic material seems to be a major predisposing factor for intratumoral gas formation. In our study, intratumoral gas was formed only in patients in whom Gelfoam was used. Intratumoral gas formation with the use of Gelfoam was also reported by Bernardino et al (3). However, in contrast to our study, in which Gelfoam was used in pledgets, they used Gelfoam in particles. Therefore, direct comparison between ours and theirs may not be appropriate. The initial tumor size in also considered as an important predisposing factor. In our series, we found that, if the tumor size the larger is a became larger, the cha-
nce for gas formation appeared to be increased.
There were some limitations in our study. We only assess two parameters, the use of Gelfoam and the initial tumor size, in the evaluation of the possible predisposing factors causing intratumoral gas formation. There can be other parameters which should be considered, e.g., the subdivision of an artery embolized, the amount of Lipiodol and chemotherapeutic agents used, or the presence of collateral pathways. The presence of underlying disease such as liver cirrhosis or diabetes mellitus might also be attributed to the gas formation.

In summary, intratumoral gas formation without clinical evidence of infection was not an infrequent finding after TAE for primary hepatic tumor, especially when Gelfoam was used. It may be a part of postinfarction syndrome and should not misinterpret it as a postprocedural abscess formation.

REFERENCES

6. 이영환, 이기열, 조성범, 차인호, 정규병 간문맥침윤이있는간세포암의경간동맥화학색전요법 대한방사선의학회지 1993; 29(4): 698-703
8. 임덕, 번홍식, 김기환, 장수일, 간세포암의간동맥색전술에의한치료효과. 대한방사선의학회지 1988; 24(6): 1063-1067
9. 이명숙, 안오주, 정은절1, 서정수1, 이정식 간세포암의간동맥화학색전술의치료효과에관한고찰. 대한방사선의학회지 1991; 27(4): 447-452

대한방사선의학회지 1994; 31(2): 327-330

원발성 간종양의 색전술후 중앙내 가스에 관한 CT 연구

김현숙·안인옥·김형진·이 구·정성훈

목 적: 원발성 간종양의 간동맥색전술후 시행한 전산화단층촬영(CT)상에서 보이는 가스의 발생빈도와 그 소견을 분석하기위함이다.

대상 및 방법: 원발성 간종양으로 간동맥색전술을 시행한 102명중 추적 CT를 시행하였던 34명을 본 연구의 대상으로 하였다. CT상에서 먼저 종양내 가스의 존재 여부에 대해서 알아보고, 종괴내 가스가 있다면 가스의 모양과 Lipiodol 섭취 부위에 대한 위치 관계에 대해서, 그리고 가스 형성과 종양의 크기 변화의 상관 관계를 qui sqare test로 알아 보았다. 임상적으로 감염에 대한 증상이나 증후가 있는 환자의 차트를 검토하였다.

결 과: 34명중 종괴내 가스는 11명(32%)에서 관찰되었는데, 11명 모두가 색전술질로 Gelfoam을 사용한 환자들이었다. 색전술전 CT에서 측정된 처음 종괴의 크기는 종괴내 가스가 생긴 굴과 종괴내 가스가 생기지 않은 굴에서는 통계학적으로 유의한 차이가 있었다(p<0.005). CT 스캔상 종괴내 가스는 그 모양이나 위치는 특별한 분포를 보이지 않았으며 어떤례에서도 도 감염을 의심할 만한 임상적 증상이나 증후는 없었다.

결 론: 원발성 간종양 환자에서 간동맥색전술후 감염의 임상적인 증거 없이 생기는 종괴내 가스형성은 드물지 않게 관찰되며 Gelfoam이 사용된 경우와 종괴가 클 경우에 가스 형성의 빈도가 높으며, 이러한 가스의 형성은 경색 증후군의 하나로 간주될 수 있을 것이라 사료된다.