

Catecholamine Surge during Image-Guided Ablation of Adrenal Gland Metastases: Predictors, Consequences, and Recommendations for Management

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ABSTRACT

Purpose: To identify retrospectively predictors of catecholamine surge during image-guided ablation of metastases to the adrenal gland.

Materials and Methods: Between 2001 and 2014, 57 patients (39 men, 18 women; mean age, 65 y \pm 10; age range, 41–81 y) at two academic medical centers underwent ablation of 64 metastatic adrenal tumors from renal cell carcinoma (n = 27), lung cancer (n = 23), melanoma (n = 4), colorectal cancer (n = 3), and other tumors (n = 7). Tumors measured 0.7–11.3 cm (mean, 4 cm \pm 2.5). Modalities included cryoablation (n = 38), radiofrequency (RF) ablation (n = 20), RF ablation with injection of dehydrated ethanol (n = 10), and microwave ablation (n = 4). Fisher exact test, univariate, and multivariate logistical regression analysis was used to evaluate factors predicting hypertensive crisis (HC).

Results: HC occurred in 31 sessions (43%). Ventricular tachycardia (n = 1), atrial fibrillation (n = 2), and troponin leak (n = 4) developed during HC episodes. HC was significantly associated with maximum tumor diameter \leq 4.5 cm (odds ratio [OR], 26.36; 95% confidence interval [CI], 5.26–131.99; $P < .0001$) and visualization of normal adrenal tissue on computed tomography (CT) or magnetic resonance (MR) imaging before the procedure (OR, 8.38; 95% CI, 2.67–25.33; $P < .0001$). No HC occurred during ablation of metastases in previously irradiated or ablated adrenal glands.

Conclusions: Patients at high risk of catecholamine surge during ablation of non-hormonally active adrenal metastases can be identified by the presence of normal adrenal tissue and tumor diameter \leq 4.5 cm on pre-procedure CT or MR imaging.

ABBREVIATIONS

GETA = general endotracheal anesthesia, HC = hypertensive crisis, MAC = monitored anesthesia care, RF = radiofrequency, SBP = systolic blood pressure

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A severe increase in blood pressure after thermal injury of adrenal gland tissue was first described by Onik et al (1) during radiofrequency (RF) ablation of a posterior right lobe liver lesion in close proximity to a normal right adrenal gland. An acute increase in blood pressure $>$ 180 mm Hg or diastolic blood pressure $>$ 110 mm Hg, or both, is referred to as hypertensive crisis (HC). HC and cardiac irritability has been reported during thermal ablation of functional primary adrenal tumors and nonfunctional metastases to the adrenal gland with incidence up to 46% (2–9). Yamakado et al (10,11) firmly established the link between the onset of HC during thermal ablation of adrenal gland tumors and

catecholamine surge by measuring the catecholamine blood levels before, during, and after RF ablation of adrenal glands in swine. As a result, medication with alpha and beta blockers was suggested before image-guided ablation of functional and nonfunctional adrenal tumors (7–9,12). In cases of functional tumors, this recommendation mirrors guidelines in the surgical literature on pheochromocytomas (13). However, in cases of nonfunctional tumors such as metastases, no guidelines exist. It is unclear how to assess the need for medication before the procedure in a particular patient without better understanding the risk factors for HC. The purpose of this study was to identify predictors of catecholamine surge during image-guided ablation of metastases to the adrenal gland, to report consequences, and to guide management before, during, and after the procedure.

MATERIALS AND METHODS

Patient Cohort

The institutional review board at two participating academic medical centers approved this retrospective study. Patients included 57 adults (39 men and 18 women) with a mean age of 65 years (SD 10; range, 41–81 y) with adrenal metastases who underwent image-guided ablation at either of two large academic medical centers between January 2001 and March 2014. The series included one patient with bilateral adrenal gland tumors from a previously published case report (14). There were 35 patients (61%) who had received systemic chemotherapy at some point during the course of their disease, and four of these patients (7%) were on systemic therapy at the time of ablation.

Disease Burden and Index Tumors

In 21 patients (37%), the adrenal gland was the only site of disease; 36 patients (63%) had metastases to other

organs. Three patients had two lesions in the same gland, and four patients had at least one lesion in each adrenal gland. Proof of metastatic involvement was available before ablation based on either biopsy in 45 patients (70%) or documentation of growth and fluorine-18 fluorodeoxyglucose uptake on positron emission tomography (PET) combined with computed tomography (CT) in 19 patients (30%) (15). The total number of adrenal tumors was 64, and most metastases were from renal cell cancer and non-small cell lung cancer (Table 1). Mean maximum tumor diameter was 4 cm (SD 2.5; range, 0.7–11.3 cm) (Fig 1).

Ablation Technique

There were 72 ablation sessions performed by 10 operators. Treatment indications included cure in 28 cases of solitary metastasis to the adrenal gland (39%), cytoreduction in 28 cases with two or more metastases involving organs other than the adrenal gland (39%), and palliation in 16 cases for large adrenal masses causing abdominal or flank pain (22%). Ten sessions (14%) were performed on lesions in previously irradiated (n = 1) or ablated (n = 9) adrenal glands. Treatment

Table 1. Adrenal Tumor Histology

Adrenal Tumor Histology	Values (n = 64 Tumors)
Renal cell cancer	42% (27/64)
Non-small cell lung cancer	36% (23/64)
Melanoma	6.3% (4/64)
Colorectal cancer	4.7% (3/64)
Endometrial cancer	3% (2/64)
Breast cancer	1.5% (1/64)
Ovarian cancer	1.5% (1/64)
Transitional cell carcinoma	1.5% (1/64)
Malignant fibrous histiocytoma	1.5% (1/64)
Hepatocellular carcinoma	1.5% (1/64)

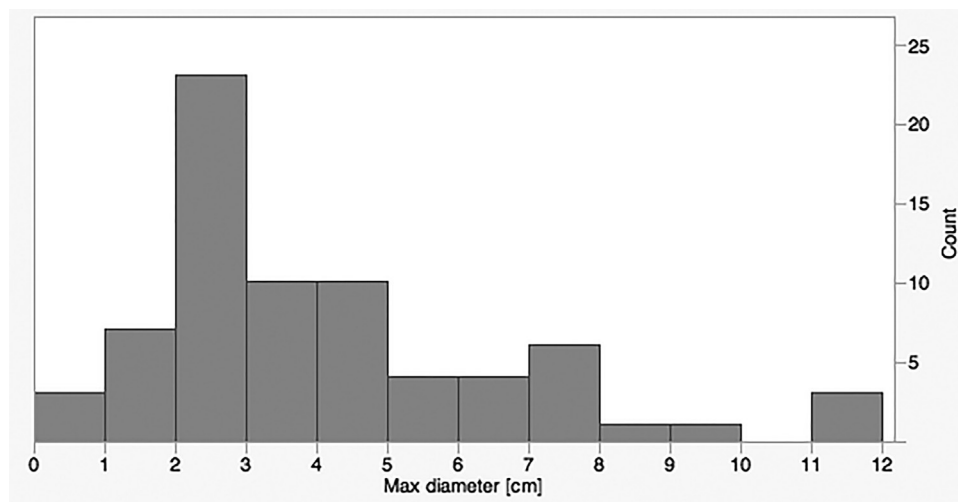


Figure 1. Distribution of maximum axial adrenal tumor diameter.

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