# Average-Weight Methodology in Weight-Based Unfractionated Heparin Therapy in the Presence of Obesity

**To the Editor:**

We applaud the recent updates to the ninth edition of the American College of Chest Physicians on antithrombotic therapy.[1] Their 2012 recommendation to use weight-based unfractionated heparin (UFH) was a remarkable advance in tailored heparin therapy. Because of the lack of definitive evidence, the ninth edition and the recent update are silent on how to address weight-based UFH in the presence of obesity. We published our limited experience with the use of *average-weight* methodology in patients with acute coronary syndrome previously.[2] In this brief report, we add to that body of knowledge our experience with patients undergoing catheter ablation for atrial fibrillation (AF).

Optimal anticoagulation is critical in preventing thrombotic complications and reducing stroke or transient ischemic attack during catheter ablation for AF. The 2012 Heart Rhythm Society expert consensus statement recommends a periprocedural activated clotting time (ACT) of 300 to 400 s.[3]

Following institutional review board approval, a single-center retrospective chart review was conducted in patients undergoing catheter ablation for AF to evaluate this prospectively initiated UFH dosing. A baseline CBC, activated partial thromboplastin time, and international normalized ratio were obtained prior to the procedure and one or more CBC were obtained the day after. Patients with an international normalized ratio > 1.5 within 24 hours of the procedure were excluded. We used the average-weight methodology to determine all weight-based UFH doses. Average weight is defined as the sum of actual and ideal weight divided by two. An IV loading dose of UFH 200 units/kg was followed by a maintenance infusion of 35 units/kg/h. Additional weight-based UFH boluses were administered to maintain an ACT of 300 to 400 s per Heart Rhythm Society recommendations. An ACT was measured within 10 to 15 min of the initial UFH loading dose, after each additional bolus dose, and every 15 to 30 min throughout the procedure. Sheath access sites were monitored for presence of hematoma twice daily until discharge. Hemorrhagic complications were assessed per Thrombosis in Myocardial Infarction (TIMI) criteria.[4] i-STAT Celite ACT point-of-care analyzer and i-STAT ACT cartridges were used (Abbott Laboratories).

A total of 78 consecutive patients was studied. Seven patients were excluded due to dosing protocol violations. Mean age was 61 ± 9 years and 76% were men. BMI ranged from 22 to 41.5, with a mean of 30.5 ± 5.2, and 61 of the patients (86%) were overweight or obese. ACT outcomes were comparable independent of BMI subgroup (Table 1). There were no cases of TIMI minor or major bleeding from the time of the procedure to discharge. One patient experienced insignificant oozing from the femoral venous access site.

Raschke et al[5,6] showed that a weight-based heparin dose, compared with a fixed dose, is a powerful predictor of successful outcome in treatment of VTE. They used total weight in determining the weight-based heparin dose, and the number of obese patients was limited in their studies. Their post hoc analysis demonstrated an increased risk of bleeding in obese patients who received weight-based heparin, although none of the patients appeared to have undergone excessive anticoagulation, as reflected by the measured activated partial thromboplastin time, suggesting that bleeding may be partly related to heparin dose.[6] Selection of proper dosing weight in weight-based UFH therapy is critical, as UFH has saturable pharmacokinetics, its dosing requirements are not

TABLE 1 ] ACT Outcomes as a Function of BMI Subgroups

| Parameter | BMI < 25 | BMI 25-30 | BMI > 30-41.5 | P Value[a] |
|---|---|---|---|---|
| No. of patients (%) | 10 (14) | 31 (44) | 30 (42) | ... |
| First ACT, mean ± SD, s | 339.1 ± 71.2 | 325.3 ± 60.7 | 327.3 ± 63.4 | .87 |
| Time to reach effective ACT > 300 s | 18.4 ± 21.7 min | 20.5 ± 17.9 min | 20.5 ± 17.5 min | .83 |
| Incidence of ACT within target range (300-400 s) during UFH infusion, % | 69.6 | 78.4 | 80.8 | .87 |

ACT = activated clotting time; UFH = unfractionated heparin.
[a]A P value of < .05 is considered significant using one-way analysis of variance to compare ACT values between three BMI groups.

directly proportional to body weight, it does not distribute into muscle or fat tissues, and it remains in the vascular circulation only.[7] Anticoagulation in obese patients continues to be a therapeutic challenge resulting in both overtreatment and undertreatment.[8,9] With increasing obesity in much of the world, use of average-weight methodology in weight-based UFH dosing represents an important opportunity to achieve the desired antithrombotic goal with efficiency and safety. This methodology was successful in achieving and maintaining the target ACT in the prevention of thrombotic events without hemorrhagic complications during catheter ablation for AF. Despite a wide range of BMI, ACT outcomes were consistent, reproducible, and independent of obesity. We have not studied patients with VTE and thus cannot comment on the efficacy of our approach in this setting.

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# Impact of Hemoglobin and Carboxyhemoglobin Adjustment on the Interpretation of Pulmonary Diffusing Capacity in a General Population

**To the Editor:**

Diffusing capacity of the lung for carbon monoxide ($D_{LCO}$) is an important test for diagnosis, monitoring of disease progression, and response to therapy. The 2005 American Thoracic Society/European Respiratory Society Standardization of Lung Function Testing Task Force recommended that $D_{LCO}$ adjustments for hemoglobin and carboxyhemoglobin (COHb) "should always be made to ensure appropriate interpretation."[1] We conducted a study to examine the impact of $D_{LCO}$ adjustment on the interpretation of individual $D_{LCO}$ test results in a general population.

Our study was a retrospective review of $D_{LCO}$ test data collected over a 12-month period in a pulmonary function laboratory (St. Joseph Hospital, Nashua, NH). This study was approved by the St. Joseph Hospital Institutional Review Board (SJH IRB File 2016-01). The primary outcome was the frequency of an adjusted $D_{LCO}$ value migrating above or below the lower limit of normal (LLN) according to Cotes et al.[2] For test data in which the unadjusted and adjusted values were both < LLN, the frequency of a test result changing severity classification was examined.[3] The frequency of an adjusted $D_{LCO}$ changing by > 3 mL/min/mm Hg was also determined.

Data from 372 $D_{LCO}$ tests were included in the analysis. Only 20 of 372 tests (5.4%) resulted in a change in normality classification ($\geq$ LLN vs < LLN) after hemoglobin and COHb adjustment. Of these tests, only two were associated with a $D_{LCO}$ value change > 3 mL/min/mm Hg, both having a low hemoglobin value. Five test results changed from normal to < LLN and 15 changed from < LLN to normal (Fig 1). Two