Effect of Obesity on Acute Hemostatic Responses to Live-Fire Training Drills

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The objective of this study was to evaluate the impact of obesity and firefighting activities on coagulation and fibrinolytic activity in relatively young, apparently healthy firefighters. Firefighters performed simulated firefighting activities for 18 minutes in a live-fire training structure. Blood samples were obtained at baseline, before firefighting, and within a few minutes of completing the activity. Nearly all markers of coagulation and fibrinolytic activity increased immediately after firefighting with an overall shift toward a procoagulatory profile. Obese firefighters exhibited lower levels of tissue plasminogen activator activity (0.98 vs 0.63 IU/ml) and higher levels of plasminogen activator inhibitor-1 activity (2.2 vs 4.5 ng/ml) at baseline compared with normal-weight firefighters, suggesting that fibrinolytic activity was lower in obese firefighters. There were few interactions between body mass index and firefighting activity, thus our findings suggest that obese firefighters did not exhibit a greater procoagulatory response to live firefighting compared with normal-weight firefighters. Acute live firefighting produced increases in both fibrinolytic and coagulatory responses; although obesity was associated with a reduced fibrinolytic profile at baseline, the changes produced by acute firefighting were similar in obese and nonobese firefighters.

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Obesity is an established cardiovascular risk factor that is associated with increased cardiovascular disease mortality and morbidity. Obese firefighters are at increased risk for on-duty coronary heart disease events and cardiovascular disease retirements.\textsuperscript{1,2} Obesity is also associated with an increased procoagulatory profile, evidenced by increased levels of fibrinogen, factor VII and factor VIII, and von Willebrand factor.\textsuperscript{3} Furthermore, obesity is associated with reduced fibrinolysis, evidenced by reduced levels of tissue plasminogen activator (tPA) and increased levels of plasminogen activator inhibitor-1 (PAI-1).\textsuperscript{4,5} In fact, the normal exercise-induced increase in fibrinolysis is blunted in obese subjects.\textsuperscript{6–7} This is of potential concern because obesity is prevalent in firefighters, with several studies reporting that approximately 70\% of firefighters are overweight or obese.\textsuperscript{8–10} Thus, it is possible that the combination of obesity with high thermal and psychological stress coupled with strenuous physical activity may produce a procoagulatory hemostatic milieu during live firefighting. However, this has not been investigated to date. Therefore, the purpose of this study was to investigate changes in markers of coagulation and fibrinolysis in response to live-fire training and to evaluate the effect of obesity on the hemostatic response.

Methods

Participants were 36 male firefighters, (19 normal weight, defined as a body mass index [BMI] <25 and 17 obese, defined as those with a BMI >30), from fire departments across the state of Illinois. Table 1 displays the descriptive data for the study participants.

This study was approved by the University of Illinois Institutional Review Board, and all participants signed an informed consent document before participation in the study. Based on health history, exclusion criteria included atherosclerotic cardiovascular disease, medications for high blood pressure or cholesterol, or medications that affect blood hemostasis.

Venous blood samples were obtained in the sitting position with little or no stasis. Baseline physiological data (heart rate and core temperature) were then recorded. Core temperature was measured throughout the firefighting activities using a MiniMitter CorTemp (Philips Respironics, Inc, Bend, OR) capsule. Heart rate was measured using a heart rate monitor (Polar Electro Oy, Warminster, PA). Simulated firefighting activities were performed in a 6-story training tower. After the simulated firefighting activities, participants immediately returned to the testing area where the same measurements and a second blood sample were collected.

The simulated firefighting activities took place on the second floor of the training building, where temperatures at waist level (1.2 m) averaged between 71 to 82°C and the floor temperatures were maintained at 35 to 41°C. Throughout the study, participants wore National Fire

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See page 1771 for disclosure information.

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