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Elemental analysis of soft plaque and calcified plaque deposits from human coronary arteries and aorta

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Twenty-five samples of soft plaque and calcified plaque deposits from human hearts or aorta were analyzed using inductively coupled plasma-mass spectrometry (ICP-MS). The determined elements were Ca, P, Na, K, Mg, Zn, Cu, Ba, Pb, Fe, Al, Si, and S. Results showed that the concentration of all elements in the soft plaque was at the micromolar level. In the calcified deposits, the concentrations of Ca and P were at least an order of magnitude higher than the soft plaque, but the other elements were at the same order of magnitude. In the calcified plaque the molar ratios of Ca/P suggested that a significant portion existed as hydroxyapatite $\text{Ca}_{10}(\text{PO}_4)_6(\text{OH})_3$. However, their absolute concentrations indicated that this compound was not a major component of the plaque although it may play a major role in determining the crystal structure of the deposit. In some samples the Ca/P ratio was too high to conform to hydroxyapatite. In others it was too low. This indicated that both the calcium and phosphorus existed in other chemical forms which varied from sample to sample. In the soft tissue the P level was high indicating it existed primarily in chemical forms other than hydroxyapatite. The presence of homocysteine is often associated with heart disease. However, the low levels of sulfur indicate that although it may be present, it is not a major component of the plaque, but may nevertheless play an important role in its formation.