SUMMARY

The purpose of this investigation was to study the effects of hypercapnia on the cardiovascular system with particular emphasis being put on its action on the cardiac muscles.

The action of high concentration of carbon dioxide has been analyzed on the mean arterial blood pressure, heart rate and force of myocardial contraction on the anesthetized cats, before and after treatment with atropine, reserpine, epinephrine and bilateral vagotomy. Hypercapnia was induced for a period of 5-15 minutes with 30% carbon dioxide in oxygen, either by spontaneous breathing from a closed chamber or by forced ventilation through respiratory pump in thoracotomized preparations. Severe hypercapnia was shown to be depressant to the cardiovascular parameters evaluated, but this was very often followed by a characteristic augmentation in the myocardial force of contraction as denoted by "posthypercapnic rebound phenomenon" during the withdrawal of hypercapnia. This was not much influenced by vagotomy, atropinization or reserpine pretreatment. This posthypercapnic rebound phenomenon appeared to be related more with the cardiac functions, and hence the subsequent studies were extended elaborately by restricting the investigation to the perfused intact and isolated cardiac muscles.

Effect of high concentration of carbon dioxide was studied on the contractile force, frequency and output of the isolated perfused mammalian and amphibian hearts, before and after treatment with atropine, reserpine and digitalis, in which the hypercapnia was induced by equilibrating the perfusing fluid for 5-10 minutes with 10-30% carbon dioxide in oxygen. Severe hypercapnia produced similar depression of the myocardial contractile force and rate...
associated with diminution of cardiac output and thereafter followed by significant increase in the force of contraction along with increased cardiac output. This withdrawal augmentation or "rebound phenomenon" was neither related with the compensatory adjustment owing to sympathetic overactivity and parasympathetic depression, nor with the associated changes with intracellular acidosis and appeared to be related to a specific action of carbon dioxide on the cardiac muscles.

Electrocardiographic studies on anesthetized rats and perfused toad hearts showed that hypercapnia produced significant depression and widening of QRS complex along with prolongation of PR, QT and TP intervals associated with marked decrease in the heart rate. Following the withdrawal of the gas, revival was associated with immediate increase in the amplitude of QRS complex. No arrhythmias (excluding bradycardia) were observed during or immediately following exposure to 30% carbon dioxide, but if the induction of hypercapnia was repeated or the duration prolonged, various types of cardiac arrhythmias appeared either during induction or after withdrawal.

Experiments with isolated toad's ventricular and cat's papillary muscles showed that hypercapnia depressed the contractility and excitability and prolonged the refractory period of the isolated cardiac muscles. After the withdrawal of hypercapnia, significant increase in the contractility and excitability along with great augmentation in rest contraction and postextrasystolic potentiation did occur confirming the view that the posthypercapnic rebound phenomenon was related more with the increase in excitability of the cardiac muscle resulting from rapid lowering of pCO₂.

Experiments with isolated heart and ventricular muscle perfused with altered ionic concentrations of Na⁺, K⁺ and Ca++ either in excess or deficit or with replacement of Ca++ by Sr++ or after EDTA treatment, showed that the effect of hypercapnia was greatly influenced by the external ionic disturbances.
Particularly the posthypercapnic rebound phenomenon as observed initially with nontreated primary perfusing solution was inhibited by $K^+$ excess, $Ca^{++}$ deficit or after digitalization, but it was further potentiated by $Na^+$ deficit.

It is concluded that the depressive action of high concentration of carbon dioxide on the cardiac muscle is specific and independent of intracellular pH changes. The increase in cardiac force and output in the intact heart or increased contractile response along with increased excitability of the isolated myocardium observed after the withdrawal of hypercapnia is probably related to increased membrane permeability and increased $K^+$ efflux and $Na^+$ influx across the membrane caused by the rapid lowering of carbon dioxide tension in the extracellular fluid.
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Finance Week

... Auto excise tax may be cut to 8 per cent

with its tight rules or tax measures, the line is expected to be held for Mr. Johnson by Wilbur Mills (Dem.), of Arkansas, chairman of the Ways and Means Committee. It is in the Senate, where action is more free, that the line can bend or break.

Talk with tax leaders in the Senate, and you come up with this list of cuts to be added to the first round:

- A cut in the auto tax from 10 per cent to 8 per cent. Cost: 365 millions.
- A slash in the local-telephone tax from 10 per cent to 8 per cent. Cost: 126 millions.
- A cut in the tax on long-distance telephone and telegraph from 10 per cent to 8 per cent. Cost: 85 millions.

Total cost of that first-round package of tax relief would be a bit more than 2.2 billion dollars. That's close to half a billion dollars more than Mr. Johnson recommends. Yet it is about what many tax leaders in the Senate expect to be approved.

Added cuts in the taxes on autos and telephone calls would be written into law to take effect each year after 1965.

Income taxes. The new Secretary of the Treasury, Henry H. Fowler, has just made it clear that high on his list of tax reforms is this: "further reductions in income tax rates."

According to official thinking, a start is likely to be made next year toward getting these rate cuts through Congress. Reductions would offer tax savings all up and down the income scale.

Specially favored, if Administration planners get their way, will be people with low incomes. Best bet: an increase in the "minimum standard deduction"—the allowance given low-income people whether they have deductible expenses or not.

Corporations are not being left out of the planning. The odds are that, when rates are trimmed for individuals, corporations will get at least two percentage points—perhaps more—whacked off their top rate.

Tightening up. Secretary Fowler is a leading member of the "sweet and sour" school of tax reform. The best time to close tax loopholes, he believes, is when tax rates are being cut.

For this reason, you can look for tax-tightening proposals to be coupled with recommendations for rate cuts.

For example, Mr. Fowler is strong for imposing the capital-gains tax at death.

In present law, if an individual holds

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