The formation of CO_2 from radioactive glucose represents only 2% of the total glucose metabolized, and its relative specific activity is low in comparison to that found in other tissues studied[9,10].

The total glucose metabolized, calculated as the sum of all the fractions measured, was about 4%. Total uptake, i.e., glucose metabolized plus glucose unchanged in the tissue, was 6.4%. The composition of the radioactive content of the insoluble residues collected was determined and was found, in small part, to consist of lipides. Exact quantitative estimation of these fats is presently being done.

Under anaerobic conditions, the only measurable metabolite formed from glucose in the popliteal artery was lactic acid, as has also been demonstrated in striated muscle[11]. The mean value of lactic acid production in 8 experiments was 64.7 ± 10.6 mg/50 mg of tissue (wet weight). Comparison between aerobic and anaerobic glycolysis (Table II) shows an apparent increase under anaerobic conditions, which has also been reported by KIRK[4]. Statistical analysis of our results shows this difference not to be significant, indicating apparent *absence of the Pasteur effect* in this tissue.

The qualitative pattern of ^{14}C-labeled glucose in the popliteal vein and in the colic artery and vein was similar to that found in the popliteal artery. The quantitative values of the intermediate metabolites, however, varied considerably, both between the arteries and their corresponding veins and between the abdominal and the limb vessels. The metabolic activity of the popliteal vein was less than half, and often only 20%, of that found in the corresponding artery. This applies mainly to the CO_2 and lactic acid production, as the other metabolites were present in amounts considered too small for accurate estimation. In the colic arteries, glucose metabolism was observed to be some 20% higher than in the popliteal arteries, and this held true for all the intermediate metabolites mentioned in Table I. In the colic vein, results indicate a metabolic activity about 40% lower than in the corresponding artery, considerably less of a difference than that observed between the popliteal artery and vein.

Tab. II. Comparison of lactate production under aerobic and anaerobic conditions

O_2	N_2
55.4 ± 5.9	64.7 ± 10.6[a]

[a] Difference not statistically significant. Results expressed as μg glucose converted per 50 mg of tissue (wet weight).

The disparity in the utilization and metabolism of glucose between the arteries and veins studied can be attributed to the difference in their histological structure, particularly as regards the larger proportion of smooth muscle fibres present in the artery. The reasons for the quantitative difference between the abdominal and limb vessels, however, is not immediately apparent. Their diversity in histological composition alone could not account for it, so we probably have to look to their dissimilarity in function and anatomic location for an explanation. The possibility should be kept in mind, however, that this difference might be less marked under normal conditions. A general anaesthetic, irrelevant of the agent, does produce a marked peripheral vasodilatation and a corresponding central vasoconstriction[12-14].

Riassunto. Il destino del glucosio generalmente mercato ^{14}C in diverse arterie e vene del cane é stato studiato con l'uso di una tecnica quantitativa di radiocromatografia su carta.

I risultati non solo mostrano che nella parete arteriosa ha luogo una notevole glicolisi aerobica ed anaerobica, ma anche chiaramente indicano che una percentuale relativamente alta di glucosio viene trasformata in amino acidi (probabilmente attraverso il ciclo degli tricarbossilici) ed in grassi.

Quantitativamente è stato osservato che il tessuto arterioso utilizza maggiore quantità di glucosio di quello venoso e che tale differenza è tanto maggiore quanto più i vasi sono periferici.

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Metabolism of the Normal Cardiovascular Wall. 2. The Pentose Phosphate Pathway

The breakdown of glucose in animal tissue is achieved mainly through the Embden-Meyerhof (glycolytic) scheme. Alternative routes of carbohydrate degradation, however, are known to exist in plants and in some microorganisms; but the actual presence and the role and significance of these routes in animal tissues have only recently been submitted to investigation.

The pentose phosphate pathway appears to be the most important of these lesser-known metabolic routes, with the extent of its utilization varying in different tissues[1-6]. It does not play a part in glucose metabolism in striated muscle under normal physiological conditions, whereas it

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is active in the liver and much utilized in the lactating mammary gland[7,8] and by lymphomas[9].

This communication gives the results of an investigation into the relative utilization via the pentose phosphate pathway of glucose in the normal arteries, veins, aorta and cardiac muscle of the dog.

Using the method of BLOOM and STETTEN[10], parallel determinations were made of $^{14}CO_2$ formed from glucose-1-^{14}C and glucose-6-^{14}C. The ratio of the fractional recoveries of radioactive CO_2 from the two labeled substances provides a qualitative index of the respective roles of the Embden-Meyerhof and pentose phosphate pathways. There are, however, several reasons why this method is not suitable for quantitative evaluation[11]; the results presented, therefore, are valid only in an *indicative* quantitative sense.

Mongrel dogs, weighing between 10 and 15 kg, were anaesthetized intraperitoneally with nembutal and an intratracheal tube was inserted for artificial respiration. The popliteal artery and vein, and the abdominal aorta, were dissected out and the adventitia was stripped off before the vessels were removed. The thorax was then opened, and a sliver of the left ventricle was taken before sacrificing the animal. The tissues, each weighing about 100 mg, were then transferred to Warburg flasks containing 1.1 ml ice-chilled Krebs-Ringer bicarbonate buffer medium at pH 7.4. The glucose concentration was 0.1% and the radioactive material was diluted with inert substrate to give a specific activity of 2 μc/mg. A small roll of filter paper, soaked with 0.5 ml of 30% NaOH, was placed in the centre well of each of the flasks, which were then attached to manometers for an incubation period of 120 min at 37°C, in 95% oxygen and 5% CO_2. The results of 6 experiments are shown in the Table. The $^{14}CO_2$ was determined by a method similar to that of VILLEE and HASTINGS[12].

When glucose degradation takes place exclusively via the glycolytic pathway, the amount of radioactive CO_2 produced from glucose-1-^{14}C and glucose-6-^{14}C, respectively, should be equal. If the ratio G-1:G-6 of the $^{14}CO_2$ yields is greater than 1, this would indicate that the non-glycolytic pathway has also contributed in some measure to the breakdown of glucose. This increase in the ratio derives from the fact that more CO_2 is formed from the 1st than from the 6th carbon.

As can be seen from the Table, although the $^{14}CO_2$ yields from the radioactive glucose-1 and glucose-6 vary considerably from animal to animal, the ratio of these yields remained relatively constant for the same tissue. Under the experimental conditions described, the ratio of the $^{14}CO_2$ yields from glucose-1-^{14}C and glucose-6-^{14}C, respectively, was 3:1 in the artery and 1:1 in the cardiac muscle. These results appear to demonstrate that the pentose phosphate pathway was active in the arteries, but apparently not in the cardiac muscle. In the aorta the ratio was about 1.5, while in the veins it was so close to 1 that, in view of the limitations of the method used and under our experimental conditions, it must be stated that the direct oxidative pathway apparently was not utilized in these tissues.

From the biochemical viewpoint, the presence of a pentose shunt, apart from other considerations, indicates: (a) the production of pentose sugars required in the synthesis of nucleic acids; (b) the formation of TPNH, an essential coenzyme for fat synthesis; (c) apparent shift in energy production, both as to conservation and dissipation.

Arising from these observations, the following physiopathological considerations present themselves: (i) What is the purpose and significance of the pentose shunt in diseased tissue? (ii) What is the role and significance of carbohydrate catabolism on lipide synthesis in the arterial wall?

Further experiments are presently being conducted, the results of which, it is hoped, will provide some of the answers to these questions.

Production of $^{14}CO_2$ from glucose-1-^{14}C and glucose-6-^{14}C in cardiovascular tissue[a]. (Each value presented below is the mean of two separate determinations.)

Dog No.	Type of tissue	$^{14}CO_2$ production in c.p.m. less background per 50 mg of tissue (wet weight) Glucose-1-^{14}C	Glucose-6-^{14}C	Ratio
1	artery	314	122	2.6
	vein	–	–	–
	aorta	–	–	–
	heart	–	–	–
2	artery	387	115	3.3
	vein	158	142	1
	aorta	–	–	–
	heart	3041	3310	1
3	artery	324	103	3
	vein	74	54	1.4
	aorta	190	114	1.7
	heart	2250	2424	1
4	artery	270	95	3
	vein	108	78	1.4
	aorta	144	98	1.5
	heart	–	–	–
5	artery	630	254	2.5
	vein	110	104	1
	aorta	181	102	1.7
	heart	2876	2714	1
6	artery	458	137	3.3
	vein	–	–	–
	aorta	133	110	1.2
	heart	–	–	–

[a] For incubation conditions see text.

Riassunto. La valutazione del $^{14}CO_2$ derivante dal glucosio-1-^{14}C e dal glucosio-6-^{14}C ha dimostrato l'esistenza di una via metabolica attraverso il ciclo dei pentosi nelle arterie del cane, mentre questa non sembra essere presente nelle vene, nell'aorta e nel'miocardio.

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