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TOLERANSIETOETSE VIR GLUKOSE

Die toleransietoets vir glukose word veral gebruik om vas te stel tot watter mate die weefsels in staat is om méér as die vastende hoeveelheid glukose op te neem. Terselfdertyd is die werklike syfer van die vastende hoogte moontlik ook waardevol. Die gewone mondelikse toleransie-kurwe ná die inname van 50 of 100 g. glukose hang ook van die dermopname van glukose af. Weens hierdie feit is die toets waardevol by die diagnose en berekening van sindrome van gebrekkige absorpsie waar 'n plat toleransie-kurwe nie vinnige assimilasie beteken nie, maar wel vertraagde absorpsie. Hierdie feit beteken egter dat die toets minder waardevol is by die berekening van glukose-toleransie, aangesien 'n mens moet begin met die ongeregverdigde veronderstelling dat die absorpsie-spoed altyd dieselfde is. Om hierdie rede is die toets ietwat gewysig sodat die glukose binneaars ingespuit kan word;[1] die ware spoed waarteen die glukose dan uit die bloedsomloop verdwyn kan in hierdie geval bepaal word. Die verskeie faktore betrokke by die gevolglike bloed-glukosehoogtes sluit in die diffusie in al die buitesellige vloeistof-spasies, die volgehoue uitskeiding deur die niere solank die bloedgehalte bó die nierdrempel bly, en die spoed waarteen die weefsels die glukose opneem totdat die vashoogte weer bereik word. Gelukkig, en ietwat onverwags, blyk dit dat die daling in die glukosegehalte vir die eerste uur ná 'n binneaarse toediening 'n eenvoudige en verklarende kurwepatroon volg.

Maar dit is nie so maklik om die resultate van die binneaarse toleransietoets uit te druk nie. Die assimilasie van glukose (d.w.s. die dalingspoed van die bloedsuiker) kan beskou word as in verband staande met òf die totale heersende bloedsuikerhoogte, òf met die verskil tussen hierdie hoogte en die voorafgaande aanvanklike vasgehalte. Hierdie twee veronderstellings verskil baie in die praktyk en gee aanleiding tot twee moontlike indices van glukose-assimilasie. Die eerste druk die spoed van assimilasie uit as 'n persentasie van die totale bloedsuiker (totale indeks); die tweede bereken die spoed as 'n persentasie van die betreklike bloed-suikergehalte bó die vastende hoogte (stygingsindeks). Daar is sekere bewyse dat die stygingsindeks die weefselopname van glukose meer akkuraat vertolk.[2] Dit staan onafhanklik van die ladingsdosis en die vastende bloedsuiker-gehalte, terwyl die totale indeks beïnvloed word deur 'n variasie in hierdie faktore. Dit is verder bevind dat die glukose-toleransietoetse op pasiënte vóór en ná karbutamied (BZ55) 'n ooreenkoms wys tussen die uitslae van die mondelikse

EDITORIAL

GLUCOSE TOLERANCE TESTS

The glucose tolerance test is designed primarily to ascertain the ability of the tissues to assimilate glucose, presented to them in excess of the fasting level. At the same time the actual figure for the fasting level may also be of value. The usual oral tolerance curve after the ingestion of 50 or 100 g. of glucose depends also upon the intestinal absorption of glucose. This fact renders the test of value in the diagnosis or assessment of malabsorption syndromes, in which a flat tolerance curve does not indicate rapid assimilation, but delayed absorption. However, this point renders the test of less value in glucose tolerance estimations, since one must start with the unjustifiable assumption of uniform absorption. For this reason the test has been modified in that the glucose may be injected intravenously.[1] In this event one can measure the true rate at which it subsequently disappears from the blood stream. The several factors concerned in the resultant blood-glucose levels include the diffusion into all the extracellular fluid space, the continued excretion through the kidneys as long as the blood level remains above the renal threshold, and the rate of uptake by the tissues until the fasting level is reached. Rather luckily and perhaps unexpectedly the fall in glucose level after an intravenous load seems to fit a simple exponential curve for the first hour.

When it comes to the method of expressing results from the intravenous tolerance test, it is not so simple. The assimilation of glucose (i.e. rate of fall of blood sugar) can be taken as related either to the total prevailing blood-sugar level or to the difference between this and the preceding initial fasting value. These two assumptions differ markedly in practice and give rise to two possible indices of glucose assimilation. The first expresses the rate of assimilation as a percentage of the total blood sugar (total index); the second expresses the rate as a percentage of the relevant blood-sugar level above the fasting value (increment index). There is some evidence that the increment index gives a more accurate expression of the tissue uptake of glucose.[2] It is independent of the loading dose and the fasting blood-sugar level, while the total index is affected by variation in

en dié van die binneaarse toets wanneer die uitslae as stygingsindeks uitgedruk word, maar daar was verskille wanneer die uitslae (van die twee vorms van die toets) uitgedruk was as totale indeks. Dit is verder bevind dat karbutamied die vastende bloedsuiker verminder, maar dat dit egter baie min verskil maak aan die mondelikse glukose-toleransie, bereken as die styging bó die vastende gehalte en die dalingspoed terug na die vastende gehalte. Dit maak dan ook geen verskil aan die binneaarse stygingsindeks nie, maar die totale indeks wys 'n merkbare vermeerdering in glukose-assimilasie onder die invloed van karbutamied.

Die binneaarse toleransietoets vir glukose kan aansluit by gepaardgaande insulien,[3] en lewer dus 'n direkte berekening van insulien-gevoeligheid of -weerstand, veral in verskillende groepe van diabetiese pasiënte. Hoewel dit eerder 'n metode van navorsing dan 'n prakties belangrike toets is, is dit ongetwyfeld 'n ondersoek wat baie meer akkuraat is as die mondelikse glukose-toleransietoets tesame met insulien.

Die grootste waarde van die binneaarse toets berus daarop dat dit die faktor van dermopname en die noodsaaklikheid om groot hoeveelhede glukose te sluk uitskakel; die feit dat die hele toets binne 'n uur afgehandel is; die toeretiese presiesheid van die uitslae wat behaal word; en die moontlikheid dat die toets met insulien verbind kan word. Aan die ander kant is dit by die mondelikse toets onnodig om 'n aarinspuiting te doen; geen aartrombose kan ontstaan nie, en die mondelikse toets sal dié pasiënte aandui waar die glikosurie veroorsaak word deur 'n vinnige absorpsie van glukose (die sg. ‚lag'-kurwe). Hoewel die toets toereties nie so betroubaar (as die binneaarse een) is nie, is dit nogtans baie waardevol in die algemene geneeskunde en selfs as 'n navorsingsmetode. Die kurwes wat behaal word is merkwaardig konstant, mits die toets onder vasgestelde kondisies gemaak word. Die ondervinding leer dat dit vir die gewone doeleindes nie nodig is om dit te laat vaar ten gunste van die binneaarse metode nie.

Die voorbereiding op die mondelikse toleransietoets is belangrik. Die pasiënt moet ten minste 4 dae lank voor die toets 'n volle dieet hou met ten minste 300 g. koolhidraat daagliks. Hy moet in vastende toestand wees met geen voedsel 12 uur voor die toets nie, en die 50 g. glukose moet in 200-250 ml. water opgelos word. Swart tee of koffie, sonder suiker, mag vir ontbyt geneem word. Die halfuurlikse bloedmonsters ná inname van suiker kan òf uit 'n aar òf uit die vinger geneem word. Die kapillêre monsters is miskien beter, mits hulle deskundig gedoen word, en hulle lewer glukosegehaltes wat ietwat hoër is as dié van aarbloed (behalwe by 'n vastende pasiënt). Monsters uit die haarvate is besonder nuttig om pasiënte uit te sonder by wie die bloedsuiker vinnig styg binne 'n halfuur, om op daardie tydstip glikosurie te veroorsaak, en dan tot die normale (of onder-normale) daal. Hierdie (‚steeple', ‚lag', of ‚oxyhyperglycaemic') kurwe kom voor na maagderminmonding of gedeeltelike maaguitsnyding, en ook by sommige lyers aan ‚funksionele hipoglikemie'.

Die glukose-toleransietoets is waardevol by die diagnose van ligte diabetes. As 'n vastende bloedsuiker van 200 mg. byvoorbeeld gevind word by 'n pasiënt met glikosurie, is dit nutteloos om 'n toleransiekurwe te neem. Dit is natuurlik ook tydverspeling om 'n toleransietoets te doen terwyl 'n pasiënt op insulien-behandeling is of 'n streng dieet hou.

these. Further, glucose tolerance tests on patients before and after carbutamide (BZ 55) have shown correspondence between results of the oral and the intravenous test expressed as increment index, while the total index differed from these. Carbutamide was found to lower the fasting blood sugar, but to make very little difference to the oral glucose tolerance, considered as the rise above fasting value and speed of return to this value. Similarly it made no difference to the intravenous increment index, but the total index showed a distinct increase in glucose assimilation under the influence of carbutamide.

The intravenous glucose tolerance test can be combined with concomitant intravenous insulin,[3] so affording a direct measurement of insulin sensitivity or resistance, especially in different groups of diabetic subjects. This, while remaining a research tool rather than a test of practical importance, certainly allows more accurate investigation than the oral-glucose tolerance combined with insulin.

The greater value of the intravenous test, therefore, lies in the abolition of the factor of intestinal absorption and the need to swallow a lot of glucose, the fact that the test is all over in an hour, the theoretical exactitude of the results obtained, and the possibility of its combination with insulin. On the other hand, the oral test does not necessitate intravenous puncture, cannot produce venous thrombosis, and will pick out the patient whose glycosuria is caused by rapid absorption of glucose (the so-called 'lag' curve). Although theoretically less exact, nevertheless its value in general medicine, and even as a research tool, is still great, and the curves obtained are remarkably constant, provided the test is carried out under standardized conditions. Experience teaches us that it is not necessary, for usual purposes, to abandon its use in favour of the intravenous method.

The preparation for the oral tolerance test is important. The subject should have had a full diet, including at least 300 g. of carbohydrate a day, for at least 4 days before the test. He must be in the fasting state, with no food for 12 hours, and the 50 g. of glucose should be dissolved in 200-250 ml. of water. Black tea or coffee without sugar is allowed for breakfast. The half-hourly blood samples after ingestion of sugar may be taken from vein or by finger prick. The capillary samples are probably preferable, provided they are expertly taken, and they give glucose levels somewhat higher than the venous blood (except in the fasting state). Capillary blood samples are particularly valuable for picking out the patient whose blood sugar rises rapidly within half an hour, to produce glycosuria at that time, and then falls to normal (or subnormal) levels. This ('steeple', 'lag' or 'oxyhyperglycaemic') curve is found after gastro-enterostomy or partial gastrectomy, and in some people who suffer from 'functional hypoglycaemia'.

The glucose tolerance test is of value in the diagnosis of mild diabetes. If, for instance, a fasting blood sugar of 200 mg. is found in a patient with glycosuria, the perform-

Dit is moontlik behulpsaam by die uitkenning van die voordiabetiese toestand, maar dit moet baie versigtig vertolk word. Nieteenstaande al die werk wat reeds in hierdie verband gedoen is, is ons nog nie seker van die normale speling by jong kinders, swanger vroue, en ou mense nie. Soos reeds gesê, is die toetse nuttig by die diagnose van ‚funksionele hipoglikemie', wanneer die bloedmonsters elke uur geneem moet word tot 6 uur na die inname van glukose. Dit het minder waarde by die hipoglikemiese toestand wat deur eilandselgewasse veroorsaak word; die kurwe is dikwels abnormaal en soms selfs diabeties van aard. By hipopituitêre kondisies en by Addison se siekte is die kurwe plat en kan die vastende gehalte laag wees. 'n Diabetiese kurwe kom soms by die Cushing-siekte en phaeochromocytoma voor, en die toleransietoets word hier diagnosties gebruik. Die veranderings by maagdermsiektes is reeds bespreek. Ook by ander siektes kan die toleransiekurwe van die normale afwyk, maar is klinies minder behulpsaam. Die kurwe is normaal by pasiënte met nierglikosurie, en beklink die diagnose by hierdie gevalle.

1. Tunbridge, R. E. en Allibone, E. C. (1940): Quart. J. Med., **9**, 11.
2. Baird, J. D. en Duncan, L. J. P. (1957): Clin. Sci., **16**, 147.
3. Lazarus, S. S. en Volk, B. W. (1957): J. Lab. Clin. Med., **39**, 404.

ance of a tolerance curve is a useless waste of time. It is of course also useless while a patient is on insulin or on a strict diet. It may be useful in the detection of prediabetes, but needs to be interpreted with care. Despite all the work that has been done on it, we are still not quite sure of the normal range in young children, pregnancy and old age. It is useful, as mentioned above, in the diagnosis of 'functional hypoglycaemia', when the blood samples should be continued hourly up to 6 hours after the ingestion of glucose. In the hypoglycaemic syndrome caused by islet-cell tumour it is of less value, though often abnormal and sometimes even of diabetic type. In hypopituitary states and in Addison's disease it is flat and the fasting level may be low. A diabetic curve may be found in Cushing's syndrome and phaeochromocytoma and it is used as a diagnostic test for these diseases. The changes in gastro-intestinal conditions have been mentioned. In other disorders the tolerance curve may also be deranged, but is of less clinical help. In subjects with renal glycosuria the curve is normal, and establishes the diagnosis.

1. Tunbridge, R. E. and Allibone, E. C. (1940): Quart. J. Med., **9**, 11.
2. Baird, J. D. and Duncan, L. J. P. (1957): Clin. Sci., **16**, 147.
3. Lazarus, S. S. and Volk, B. W. (1957): J. Lab. Clin. Med., **39**, 404.