Doping tests at the Olympic Games in 1976*

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The analytical testing of the non-medical use of drugs at the Olympic Games in Montreal marked a certain number of steps forward in the long and difficult fight against doping started some years ago by the IOC, the International Federations and other organisations interested in safeguarding the health of athletes and the image of amateur sport. This concentration of disinterested efforts led to the organisation of the first tests at Grenoble in 1968 ; it has continued ever since and, at each Olympiad, has given rise to new steps establishing important precedents. In the evolution of the modern history of doping tests, Munich, for example, was marked by scientific and technological advances that made it possible to test rapidly a large number of samples daily and to detect a much wider range of medicines than had hitherto been possible.

While largely inspired by the example of Munich, Montreal made a vital contribution to progress in doping tests. Thus, for the first time, full use was made of the multiplicity of scientific branches inherent in a properly structured programme of doping tests. For the first time, doping with anabolic steroids was successfully detected and tested by scientific means. For the first time, the IOC Medical Commission was assisted in its daily work by a consultative committee of experts appointed to solve certain specific problems that arose during the Games. It is this experience that we propose to describe here.

Recapitulatory table of patients receiving medical treatment from the Health Department

	Athletes	Officials	Spectators	OCOG	Totals
Stadium	81	21	987	654	1743
Olympic swimming pool	93		172		265
Cycle-racing track	26	34	87	24	171
Maurice-Richard	29	4	31	123	187
Maisonneuve	46	20	12	31	109
Pool	30	11		52	93
Claude Robillard	67	4	66	56	193
Etienne Desmarteau	104		72		176
St. Michel	7	1			8
Forum	10		20		
Paul Sauvé	10	2	2	16	30
Montreal University	66	26	9	12	113
Molson	32		4		41
L'Acadie	5	5		4	
Bromont	62	43	29	138	272
Joliette	1				5
Sherbrooke	42		73		115
Toronto	15	5	8	12	40
Ottawa				11	13
Kingston	89	60			152
Kent Park			6	27	
Polyclinic O. V. [1]	4138	284		622	5044
Kiosk, Olympic Park	119	3	260	300	682
Totals	5074	530	1842	2085	9531
Special clinics					
Youth Camp	619				619
International Centre, O.V.				54	54
Press clinic					
IBC			210		210
RBC			959		959
Desjardins Square (Press Centre)			120	101	221
Physiotherapy (polyclinic only)	4266				4266
	9959	530	3131	2240	15860

[1] O.V. : Olympic village.

The preparation of the practical arrangements

After many consultations with the Medical Commission, the OCOG's health department set up, in 1974, a special section responsible for the logistic and organisational aspects of doping tests. Thus a coordinator, responsible to the head of the scheme, was appointed to plan the practical arrange-

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Prince Alexandre de Mérode (BEL), here in the company of Dr. Hart (USA) at Lake Pacid.

ments. The main tasks of this official were in particular to plan, in cooperation with the architects responsible for the Olympic sites, the setting up of doping control centres in keeping with certain required standards of comfort, accessibility and security. Services were also set up for the supply, distribution, recovery and testing of equipment. A programme for training the medical teams responsible for taking the samples was organised and a timetable worked out for the whole period of the Games. Finally, a department was created to coordinate the teams responsible for identifying the athletes selected for testing at the time of the contests and for accompanying them to the centres indicated.

Particular attention was paid to the training of the medical personnel responsible for taking samples. Experience, moreover, has shown that this is a key factor in the success of the sample taking stage. In the weeks preceding the Games, the teams were given intensive training during which different scenarios were staged for the purpose of judging their reactions to unexpected situations. Another important part of the training consisted in making the personnel aware of the fact that the tests should be carried out with respect, discretion and understanding, while strictly observing the standards laid down by the Medical Commission. We believe that making the environment as comfortable as possible for the athletes probably helped to eliminate potentially unpleasant incidents likely to occur in this type of situation.

The selection of the athletes

In accordance with customary practice and the conditions clearly laid down for each sport, the athletes selected for testing were chosen during and after each event by the Medical Commission in agreement with the International Federations and the Organising Committee. Representatives of the-latter invited the athletes to be tested to accompany them to the testing centre where samples were taken. Owing to the still rudimentary state of evolution of anabolic steroid tests, the samples for this type of test were almost always taken at the polyclinic in the Olympic village. In addition, and this represents an innovation, about twenty per cent of the samples taken for the anabolic steroid tests ‘were in fact taken before the actual start of the Olympic Games. We believe that this practice should be continued in future because it constitutes an additional means of dissuasion by discouraging administration of these substances.

The sampling procedure

As a result of the experience gained at earlier Olympic Games, the sampling pro-

cedure was slightly modified at the meeting of the Medical Commission in Montreal in April 1975. The fundamental principles determining the changes, adopted later by the International Federations, were of two kinds. First of all, a point was made of drawing up a series of safety precautions that would guarantee, both individually and collectively, the integrity of the testing system. Finally, a more modern system for sealing the samples was devised, which eliminates both the human errors inherent in the use of diamond-tipped pencils for marking the bottles in code and the dangers involved in the use of wax as a means of sealing them.

A method was adopted, therefore, in which a pre-numbered adhesive tape, which served both as a seal and as a means of identification, was affixed to each bottle. This adhesive tape, resistant to acids, alkalis, organic solvents and similar substances, was unique in its characteristics and identifiable, by a limited number of persons responsible for the system, by its particular fluorescence. In addition, two particular characteristics of the surface of this seal also ensured that it was impossible to change it without the fact being immediately visible. An extremely close check was kept on the issue and collection of these tapes throughout the period of the Olympic Games.

Once the tapes had been fixed to the two bottles, each containing part of the sample, access to either of them was further protected by the application of a heat-sensitive envelope also with unique characteristics. The effect of a strong blast of heat on this envelope ensured its constriction round the bottle and the stopper. The combination of the two seals was such that any attempt at unlawful handling could easily be detected.

After each of the bottles had been slipped into a protective polythene bag (to avoid accidental breakage during transport), the whole batch of samples taken was put into a box, which was then sealed. This box was immediately taken to the laboratory by two people. It very seldom took longer than two hours between the time the samples were taken and the arrival of the bottles at the laboratory.

At the laboratory, two people appointed for the purpose signed for the samples, checked that the seals were intact and only accepted the batch of samples if no irregularity 'was visible. The check-samples for use as a double check (in the event of a positive result) were immediately placed under lock and key in a refrigerated vault to which only the head of the laboratory had access.

As stipulated in the regulations of the Medical Commission, a strict check was maintained on all persons authorised to enter the laboratories. The laboratory staff then tested the samples giving priority to certain team sports as requested by certain international Federations. In spite of the difficulties involved in the daily analysis of a large number of samples, during the Games all samples were tested within twenty-four hours of their arrival at the laboratory. The analysis of the samples taken for the anabolic steroid tests was naturally an exception to these rules since, at the present moment, this type of test takes several days to complete. The improvement of existing techniques and the development of new methods of analysis enable us to foresee that it will soon be possible to test for anabolic steroids as quickly as for traditional doping substances.

Scientific and technical aspects

One often tends to forget, to underestimate or even simply to realise the technical and scientific complexities of the analytical doping controls, especially when they have to be carried out during Olympic Games. We would remind you that it is the IOC's policy to prohibit only those potentially doping substances for which there exist one or more scientifically reliable analytical techniques of detection and identification. To accuse an athlete of doping merely on the basis of clinical impressions-no matter how justified they may be—is not sufficient motive for intervention. it is essential to prove the presence of the medicine (or a metabolite) in the samples of urine taken, under clearly defined conditions laid down in regulations drawn up not only for the protection of athletes, but also for the integrity of the whole testing system.

Other factors have also to be taken into consideration. The ever growing number of medicines liable to misuse (some of which are used only in specific parts of the world), the possible need for laboratories

Breakdown of patients at places of competition according to category of diagnosis

	1	2	3	4	5	6	7	8	9	10	11	12	Totals
Stadium	12	33	96	108	4	291	167	5	18	112	87	810	1743
Swimming pool	1	1	20	11		62	26		4	24	21	95	265
Cycle-racing track		3	6	8		49	3	13	1	9	38	41	171
Maurice-Richard		1	7	5						22	10	123	187
Maisonneuve		1	1	1	3	26					24	53	109
Pool			8	1		18	2		3	14	19	28	93
Claude Robillard			3	4		4			3	77	55	47	193
Etienne Desmarteau		1	8	5		62	2		2	17	20	59	176
St. Michel										1	7		8
Forum				1		3			1	2	11	14	32
Paul Sauvé			3		2	15				2	8		30
Montreal University	1		4	6	2	23	5	1	1	2	33	35	113
Molson						2				3	31	5	41
L'Acadie			6	1	1	1			1		2	2	14
Bromont	3	9	29	6	4	28	2	13	16	74	47	41	272
Joliette				1					1			3	5
International Centre												54	54
Sherbrooke			2		1	24			1	3	84		115
Toronto											8	32	40
Kiosk, Olympic Park	6	4	57	42	12	126	36		13	68	131	187	682
Kingston		17	32	4	4	8			1	11	54	21	152
Kent Park			6	6		6				3	5	7	33
Ottawa												13	13
IBC		1	34	10		44				16	6	99	210
Desjardins Square												221	221
RBC												959	959
Polyclinic	5	242	267	83	9	165	31	3	50	150	3142	897	5044
Totals	28	313	589	303	45	973	274	35	116	610	3843	3846	10975

1. Cardiovascular
2. Dental
3. E.N.T.
4. Gastro-intestinal
5. Infectious diseases
6. Injuries
7. Neurological
8. Psychological
9. Respiratory
10. Skin
11. Musculoskeletal system
12. Miscellaneous

to prove the presence of a metabolite endogenous to the medicine in the event of a positive result, the delicate problems inevitably raised by a positive result, which has to be confirmed later by means of the check-sample, the speed with which it is necessary to deliver the results to the Games are all factors requiring the analytical methods to be rapid, reliable, precise, reproducible, thoroughly tried and tested, and based on advanced instrumental technology.

The working out, setting up and implementation of a system of detection and identification of doping substances must finally take into account the growing multiplicity of the branches of physical, chemical and biological sciences. The detection and the identification of medicines and their metabolites in biological fluids involve recourse to analytical chemistry, physical chemistry, organic chemistry and biochemistry, both traditional and molecular. Similarly, the techniques for interpreting the results involve recourse to pharmacokinetics, pharmacology and physiology. Finally, the critical methods of evaluation call on statistics and cybernetics.

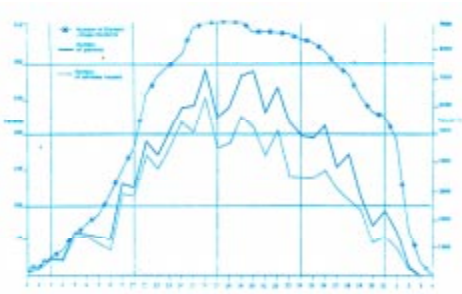
The team of scientists—from the Centre for Research into the Science of Health at the National Institute of Scientific Research in Montreal-responsible for the doping tests carried out at the Olympic Games, was largely inspired by these broad principles. The basic strategies and the experimental methods proved original in several ways while being in keeping with the present trend in the detection of medicines in biological fluids. It can be pointed out, for example, that the active exchange of information between scientists in different branches has made it possible not only to

modify tactics rapidly when these proved unpromising, but also to follow up and quickly implement an interesting idea.

Systematic studies of urinary excretions and the metabolism of prohibited substances under various physiological conditions were also carried out during the three-year period preceding the Games. The excretion of certain medicines being quantitatively influenced by modifications in the degree of acidity of the urine as a result of muscular exercise or even the drinking of alkaline beverages, made it important to study the speed and degree of excretion of these medicines after a normal pharmacological dose. Consequently, it proved necessary to study the metabolic transformation of the prohibited substances since several of them are only excreted as such in the urine in very small proportions, often impossible to detect. Under such conditions, the identification of one or more metabolites constitutes sufficient proof. During the Games, the laboratories were able to act not only as a policing instrument but also as an important consulting tool for the IOC Medical Commission.

The systems of detection

Since the 1960's, gas chromatography has been the ideal technique for the detection of doping substances. It is, however often difficult to apply because the normal urinary constituents often create interference or extraneous signals which make it hard to detect the substances looked for. At the Institute, these difficulties were overcome by equipping the instruments with a new detector possessing a selective sensitivity to the doping agents. This made it possible to increase the degree of detection of the products looked for and to reduce to a minimum the interference of the urinary constituents. This technique was not applicable to anabolic steroids. Research is at present being carried out in our laboratories to enable the properties of this instrument to be used for the detection of anabolic steroids at degrees of specificity and sensitivity similar to those that it is at present possible to achieve for conventional doping substances. By 1978, we expect that it will be possible to detect the presence of anabolic steroids in less than two hours and to identify them in less than twelve. At the present moment, one of the difficulties inherent in the efficient detection of steroids is the time taken for such tests (from two to four days).

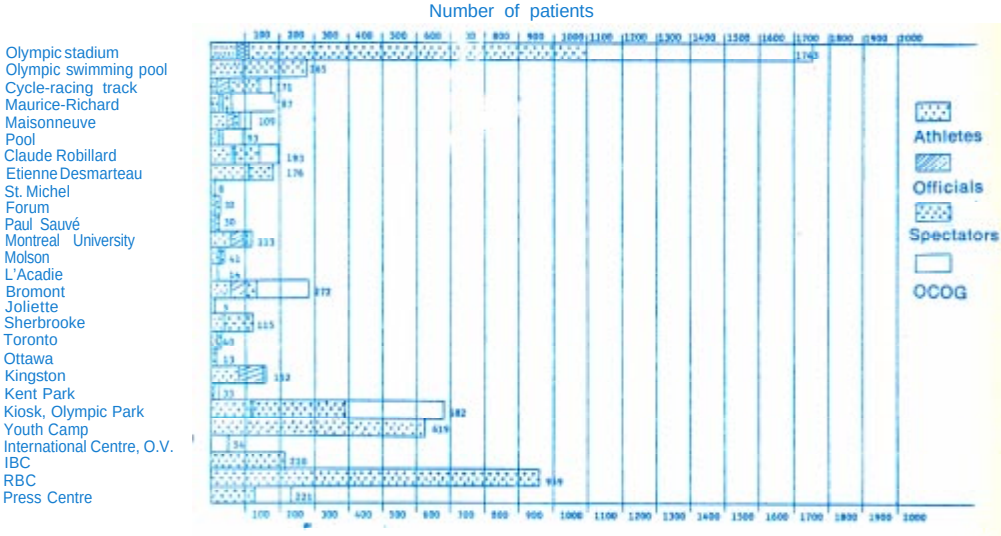


Comparative table :
Number of patients at the O.V. Polyclinic, number of athletes treated, and number of people residing in the Olympic village

Another element of vital importance in the operation of such a laboratory at a large scale sports meeting is the ability to reduce to a minimum the risks of human error and to be able to interpret the chromatographic results quickly. This was achieved in the Montreal laboratories by connecting the chromatographs up to automatic systems for the introduction of samples and to computers possessing the software needed for the numerical standardisation of the results.

In this way, the results of each of the samples tested were presented simultaneously in the form of a graph and in the form of an identified analytical report, after being compared with the data banks stored in the computer memory. Greater security was also achieved by storing the results in a permanent card index, in case it were ever necessary to process them through modified software.

The method of detection used for anabolic steroid tests was the radio-immunassay test developed by Professor Raymond Brooks at St. Thomas's Hospital in London. This rather complicated technique is useful for mass detection as is the case at the Olympic Games but, like all methods of detection, it constitutes only a preliminary test in the sense that the results produced are no more than an indication that further analytical tests should be carried out.



Breakdown of patients treated *at clinics according to categories*

The systems of identification

It is important to stress that the present method of detection (gas chromatography for traditional doping substances and radio-immunassay for anabolic steroids) only give indications concerning the possible presence of a medicine but do not in any way constitute formal and definitive proof. A scientifically valid and unquestionable conclusion can only be obtained by submitting a sample to more advanced processes. Within the context of a sports event, whether the Olympic Games or a regional championship, it is absolutely essential to possess methods and means of action that give results whose scientific validity cannot be questioned. This is all the more necessary as the reputation and the career of an individual may be at stake.

The technique which at present satisfies these criteria best is the gas chromatographic/mass spectrometric method connected up to a data processing. system. Without dwelling on the complicated aspects of this technique, let us just say that the instrument used produces, by electronic bombardment of a medicine, a series of ionic fragments whose graph constitutes a mass spectrogram. The most interesting characteristic of this technique is that the probability of two different molecules producing the same spectrogram is nil. In this respect, therefore, a mass spectrogram is, for a medicine, a characteristic as unique as finger prints are for a human being. To our mind, there is no doubt at all that doping control laboratories should be required to carry out spectrometric analyses of the results and that punitive action should be taken only when it is certain that such an analysis has been carried out.

Gas chromatography/mass spectrometry has proved particularly useful in the confirmation of anabolic steroids. Thanks to the techniques developed in our laboratories, it was possible during the Games to identify the nature of the steroid administered, thus enabling the sanctions, with which you are all familiar, to be taken subsequently.

The doping control consultative committee

An interesting move in Montreal was the setting up of a consultative committee formed of several well-known university professors from leading Canadian medical faculties. The President of this committee

was responsible both to the Chairman of the Medical Commission and to the head of the doping control programme. His responsibilities were many and consisted mainly in assisting the Medical Commission in a number of its activities. For example, the committee consulted several team doctors concerning prohibited medicines and helped rapidly clear up certain scientific problems that arose during the Games. In view of the many medical questions raised during the Games and the limited availability of members of the Medical Commission whose timetable was very full, it is probably a good idea to repeat this experience at future Games.

Results and future prospects

Certain definite trends can be detected in the results achieved at the Games in Montreal. Out of 1800 analyses carried out as part of the testing of traditional doping substances, only three samples proved positive. It may, therefore, be deducted that the use of psychomotor stimulants is definitely on the decline owing to the existence of the means of dissuasion constituted by a testing laboratory. For the first time in the modern history of doping tests at the Olympic Games, some 275 analyses testing for anabolic steroids were carried out and 8 positive results were reported to the IOC Medical Commission, which represents a proportion of 3%. It is likely that the very small number of positive results is due to the prohibition, later widely publicised, ordered by the Medical Commission at its meeting in Innsbruck in 1974.

It is also very likely that the problem of doping with anabolic steroids will decline in the same way as that of psychomotor stimulants. This will, however, call for efforts at various levels. It is first of all essential to continue actively the research projects aimed at reducing the time required for analysis, at simplifying methods so that they can be adopted by other laboratories throughout the world, and at devising more sensitive and more specific techniques.

In view of the very nature of doping with anabolics, which are usually administered during training and not necessarily in direct connection with a competition, it will be necessary to define the mechanisms by which this test can be carried out in a framework other than the actual competitions (without however excluding the possibility of tests during competitions). This, however, raises very considerable difficulties, whose organisational and financial aspects are not the least formidable by any means.

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A conclusion that must also be drawn is the fact that the testing systems must be kept up even though doping with certain types of medicine seems to be on the decline. On the other hand, the maintenance and widening of these mechanisms will probably encourage some people to think up new means, either by circumventing the tests or by using new doping techniques. In both cases, we must be on our guard.

Thus it is common knowledge that new products with stimulating properties are continually being discovered and quickly become available. Athletes may be tempted to use them. But the methods of detection and identification also continue to evolve -and this is a recent phenomenon—at a more rapid pace than the discovery and launching of new products. The present period marks perhaps an important step forward from the point of view of the fact that the testing possibilities placed at the disposal of sports authorities are no longer outpaced by the attempts to circumvent them.

It is well known that the present trend in doping seems to be directed towards the exogenous addition of normal physiological constituents. Such practices, as senseless as they are dangerous and useless, will certainly become detectable in a nearer future than is generally thought. You have only to remember that for a long time it was thought that anabolics were neither detectable nor identifiable.

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