Identifying patients at high risk of coronary events is the main focus of cardiovascular prevention. For primary prevention score and risk cards are very low cost solutions, but only of limited efficacy, thus justifying the use of non-invasive imaging testing for the purpose of increasing the ‘diagnostic gain’. Considering all the diagnostic tests employed, only few demonstrated significant additional contribution to the risk score stratification. Coronary imaging with high speed volumetric computed tomography can provide essential information in ruling out and/or definition of coronary artery disease but also has limitations as far as the biological risk, the costs, and the difficulties of putting into perspective the results obtained in asymptomatic patients.

Introduction

Prevention of acute coronary syndromes (ACS) and coronary artery disease (CAD) is an important public health goal. In fact, mortality and morbidity for ACS and CAD and/or their sequelae is very high, constituting the leading cause of death in the Western world.1 Numerous studies have also shown that the appropriate use of treatments able to influence the progression of coronary heart disease and to affect its stabilization (statins, anti-platelet, effective anti-hypertensive treatment) reduces acute coronary events, hospitalizations, as well as immediate and long-term mortality.2–4 The strategies commonly used in primary prevention are basically two:

• The population strategy, extended to the whole population and focused on the adoption of appropriate lifestyles;
• The personalized intervention strategy based on the risk of individual events, usually focused on the estimation of the individual risk of events established on the basis of ‘Scores’ or ‘risk tables’.

The strategy of personalized intervention is certainly cost-effective but has its main limitation in the correct identification of subjects at intermediate or medium-low risk. For the latter, it may be useful to add an additional test to the initial stratification that can bring an additional contribution and facilitate the identification of those individuals at higher risk.

Several non-invasive imaging tests have been investigated in the risk assessment of ACS in addition to the risk scores. The most frequently used non-invasive tests are those that explore the presence of preclinical vascular damage in peripheral districts (carotids, arteries of the lower limbs) or in the coronary district.

Non-invasive imaging of the carotid district and lower limbs

Several population studies have shown that atherothrombotic involvement is multi-district and consequently the uncovering of subclinical atherosclerosis in peripheral districts, that can be evaluated with non-invasive methods, can improve the risk stratification performance of coronary events in subjects who do not reach the risk threshold for ‘intensive’ drug treatment.

The study of the carotid district has traditionally been based on the intima-media thickness complex (IMT), a...
predictor of events more in women than in men and in a non-linear manner. The lack of well-defined standardiza-
tion criteria and the lack of ability to improve the predic-
tive capacity of some algorithms such as Framingham have
effectively excluded the utility of this test in the last European Society of Cardiology (ESC) 2016 guidelines.

Greater usefulness would seem to have the presence of
carotid plaques responding to diagnostic criteria based on
thickness (IMT > 1.5) and on the percentage of vessel ste-
nosis (>50%), but predictability is greater for cerebrovas-
cular events than for coronary ones.

The ABI (Ankle/Brachial Index) is closely correlated to
the frequency of major cardiac and cardiovascular events
(MACE) but its usefulness in the redistributing of patients
at intermediate risk is questioned in the ESC guidelines on
cardiovascular prevention and rating of recommendation
of the method is rather low (IIb).

The search for a peripheral vascular disease is also useful
in patients who have undergone an acute coronary event,
in secondary prevention, to establish which patients should
be treated more intensively for the reduction of MACE and
also of mortality with dual long-term platelet anti-aggrega-
tion or with lipid-lowering agents.

The calcium score

Calcium score (CAC) quantification with electron beam
or multi-slice CT (computed tomography) is based on the
assumption that the extent of coronary calcifications cor-
relates with plaque burden and therefore with the proba-
bility of coronary events. Although the presence of calcium
indicates ‘stable’ plaques, there is a discrete correlation
between Agatston score and the probability of coronary
events. An Agatston score >300 or more than 75% pre-
dicted for age and sex indicates an increased risk and is
helpful in re-structuring low-risk subjects. Furthermore, a
negative CAC is usually associated with a low probability
of coronary events (!).

The use of the test obviously clashes with the related
costs and the biological risk related to radiation exposure
(0.8–1 mSv).

Coronary computed tomography

The possibility of obtaining non-invasive coronary imaging
has necessarily aroused the interest of clinicians, espe-
cially due to the extraordinary technological innovations
that have occurred in the last decades. From the comput-
erized axial tomography, to the multi-detector ‘spiral’ CT
and to the current ‘volumetric’ CT scan. Volumetric CT has
today made a huge leap in cardiovascular imaging technol-
gy, thanks to the ultra-fast production of high resolution images. The
new tomograms, with a scan time of just
0.28–0.35 s, are able to cover an entire anatomical district,
such as the heart, from the emergence of the great vessels
at its apex: 160 mm of volumetric acquisition. The direc-
tion taken by cardio-coronary imaging with volumetric CT
is the ultra-fast production of high resolution images. With
very rapid times of carrying out the examination and with
the reduction of more than 10 times (from 14-20 to 0.8–1.8 mSv!)
of the dose of ionizing radiation absorbed by the patient.

The extraordinarily fast acquisition times make it possible
to reduce the amount of contrast medium, with greater
safety of the examination even in patient with nephropa-
thy. The more sophisticated imaging acquisition also allow
to evaluate the ‘composition’ of the plaque in order to es-
ablish the possibility of ‘instability’ of the plaque. The
negativity of the scanning study indicates the subject at
low risk with extreme precision. The subjects at high risk
are instead identified by the presence of non-critical mul-
tivessel coronary disease, as well as by patients in whom
‘critical’ stenoses are identified. Although the advantages
of the technique are clearly evident, different limits must
be considered:

- The cost of the method;
- The biological risk related to radiation exposure, how-
ever limited, and the need for contrast medium;
- The relief in asymptomatic subjects of critical steno-
oses in the absence of symptoms, a finding that deter-
mines further investigations and often results in revascu-
larization whose utility has not yet been established.

Non-invasive imaging for the study of
ischaemia

Methods for the study of ischaemia include ECHO-stress,
perfusion myocardial scintigraphy, and nuclear magnetic
resonance during pharmacological stress test. The patho-
physiological assumption for the use of these methods is
that inducible ischaemia is usually associated with a ‘func-
tionally significant’ coronary stenosis, but in reality it is
still not clear what the risk of coronary events is in the
presence of inducible ischaemia. In all the studies on the
topic, some very dated and conducted in the pre-statins
era, the risk of overall coronary events appears to be
greater in patients with severe ischaemia (>10% of left
ventricular extension). The ISCHEMIA TRIAL study is
currently underway, from which there will certainly be many
indications on the topic and some definitive answer on the
connection between inducible ischaemia and events or be-
tween coronary heart disease and events.

In the ischaemia trial, most of the patients were selected
with image tests, especially myocardial scintigraphy and
ECHO-stress. Advantages and disadvantages of these meth-
ods are known. Myocardial scintigraphy involves significant
radioactive exposure, but it is certainly more precise and
less operator-dependent in the evaluation and quantifica-
tion of ischaemia. Echo-stress is surely the most available
and least correlated to biological risk, but dependent on
the acoustic window and the experience of the operator.
The nuclear magnetic resonance is unfortunately not very
available and certainly more complex, although it is very
effective in the diagnostic evaluation in terms of sensitivity
and specificity.

In assessing the risk of events in patients at intermediate
risk, the search for ischaemia is not recommended, beyond
what the peculiarities of the methods used are.
Conclusions

In the stratification of the risk of heart attack in primary prevention the role of non-invasive imaging is modest, despite the considerable interest that is currently receiving the non-invasive imaging of coronaries with the ultra-fast volumetric CT scan. The lower cost techniques are characterized by a very weak ‘diagnostic yield’, the exceptional diagnostic capacity of the ultra-fast volumetric CT scan for the non-invasive study of the coronaries leaves obvious doubts in the clinician for the application of an expensive method, however related to a non-negligible biological risk in asymptomatic and presumptively disease-free subjects.

The stratification of the risk of events on a clinical basis and with risk scores remains the best way to establish the appropriate treatment of these patients.

Conflict of interest: none declared.

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