Resumen
Objetivo: Determinar las características de desempeño de la ecografía en el diagnóstico de las hernias de la región inguinocrural en pacientes con manifestaciones clínicas de pubalgia del deportista.
Material y Métodos: Fueron realizadas ecografías de la región inguinocrural en forma bilateral a 400 pacientes consecutivos con pubalgia (800 regiones inguinocrurales exploradas; 379 pacientes de sexo masculino y 21 femenino; edad media: 28 años, con un rango de 16 a 45 años). Todos los pacientes eran deportistas -profesionales o amateurs-, provenientes íntegramente de un centro de medicina deportiva, derivados por un subespecialista en pubalgia. Los hallazgos ecográficos fueron comparados con los de la cirugía laparoscópica o con los resultados del examen físico y eventual seguimiento por consultorio externo. En consecuencia, se determinó la sensibilidad, especificidad y los valores predictivos positivo y negativo de la ecografía para el diagnóstico de hernias de la región inguinocrural en este grupo de pacientes.
Resultados: Se detectaron hallazgos ecográficos que sugirieron la presencia de hernia en 128 regiones inguinocrurales (100 pacientes, 28 bilaterales). Al ser comparados con los de la cirugía y la clínica, la sensibilidad del método fue del 96,96% y la especificidad del 100%; los valores predictivos positivo y negativo de la ecografía para el diagnóstico de hernias de la región inguinocrural en este grupo de pacientes fueron del 100% y 99,4%, respectivamente.
Conclusión: La ecografía es un método de alta exactitud diagnóstica para la detección de hernias que no son evidentes o bien de naturaleza equívoca en pacientes con pubalgia del deportista.
Palabras clave: Hernia, Inguinal. Abdominal Wall. Ecografía.

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weakness associated with hernia. Given the diverse etiologies that can cause it, a multidisciplinary approach is relevant for the diagnosis (2). Recent studies have shown that Magnetic Resonance (MR) is the most effective method to identify lesions which involve muscular structures and pubis symphyses, while the recent tendency is that ultrasound replaces the herniography as the method chosen for the diagnosis of hidden hernias (4-7).

The aim of this study is to value the diagnostic accuracy of ultrasound in the detection of inguinocural hernias as one of the possible causes for athletic pubalgia in those patients who did not have concluding physical examinations.

MATERIAL AND METHODS

Study Population

In this retrospective study, 432 consecutive patients were evaluated between January 2007 and December 2008. These patients were referred from a sport medicine center by only one subspecialist surgeon in inguinal pain. Absences to check-ups or to ultrasound exams were considered as exclusion criteria; for this reason, 32 patients were not included and this lead to a final number of 400 patients (379 males, 21 females, mean age 28 years old; ranging from 16 to 45). An ultrasound of both inguino-cural regions was performed to all of them, being the definitive objective of the study, 800 regions explored in 400 patients.

An institutional approval was obtained from the sport medicine center for the inclusion of patients and they signed an informed consent.

Reference Standards: Symptoms and Surgery

All referred patients were athletes (70% amateurs and 30% professionals) with clinical history of more than 3 months with inferior abdominal pain. An initial clinical exam was performed, which determined the division in two big groups: those with high inguinal pain and those with low inguinal pain. Complementary exams were not performed on patients with low inguinal pain and with hernia evidence detectable with a physical examination.

In the initial stage, the available studies for patients with diagnosis of athletic pubalgia and without a cause that justified it at the time of the clinical examination were ultrasound, Magnetic Resonance (MR) and scintigraphy. Subsequently, this last study was no longer used because it did not show additional or significant information. Patients had an operation, based on the clinical exam and on the results obtained with the complementary studies. Two reference standards were used to evaluate the performance of ultrasound: clinical and surgery; in patients who had an operation, results of laparoscopic surgery; in patients who did not have an operation, subsequent clinical check-ups in external office.

Ultrasound Examination

The ultrasound explorations were performed with a Xario or Nemio (Toshiba) or a HDI 500 (Phillips) equipment with multifrequency transducers of 5 to 12 MHz. All exams were performed by two sonographers (AB and JEZ, with 27 and 22 years of experience post residency in the specialty, and 6 and 3 years of experience in ultrasound performed on patients with athletic pubalgia, respectively).

The exploration technique of the inguinocural region was the one described in the literature (7-9). The necessary and essential anatomic repairs that made the classification of the hernias possible were the limits which define the Hesselbach triangle (inferior epigastric artery, external edge of anterior rectum muscle and inguinal ligament), to which we added the pubis’ tubercle (Fig. 1).

To start with the exam, the transducer was put in the axial plane at the height of the navel, over the lateral side of the anterior rectum muscle (Fig. 2).

Once the inferior epigastric artery was localized, it was followed in cranial-caudal directions up to its origin in the external iliac artery (Fig. 3).

This confluence is the reference point to define the profound inguinal ring of the inguinal path. Immediately caudal to him, there is the inguinal ligament, which medial extension goes from the origin of the inferior epigastric artery to the pubis’ tubercle. When
slightly spinning the transducer from the strict axial plane, orientating it to the pubis’ tubercle, the inguinal ligament can be identified as an echogenic band (Fig. 4).

The superficial inguinal ring or anterior opening of the inguinal canal is a defect of the external oblique aponeurosis, of superior location and lateral to the pubis’ tubercle (Fig. 5).

Consequently, the inguinal canal is examined in its two axes: short and long.

The Indirect Inguinal Hernia is defined as the extrusion of fat, intestine or of both of them though the internal inguinal ring with extension to the inguinal canal, parallel to its long axis (Fig. 6 and 7).

Direct Inguinal Hernias are usually detected in the inferior aspect of Hesselbach triangle, although since they can be on any of its limits, they should be examined entirely (Fig. 8 and 9).

Femoral hernias are located underneath the inguinal ligament and medial to the femoral vein (Fig. 10 and 11).

In all cases in which anatomic repairs that define the localization of possible hernias have been localized, the patient is examined while resting and with a controlled Valsalva maneuver. That is, wherever the rise of intraabdominal pressure is gradual.

In conclusion, the hernia is defined as the extrusion of content through the inguinal canal or any sector contained within the limits of Hesselbach triangle. The exam must be extended to the inferior limit of the inguinal ligament to include the femoral hernias. This exam is performed at rest and after gradual Vasalva.

In addition to reaching the diagnosis, ultrasound is able to identify the variety of the hernia and to provide additional information such as the content and its capacity of being reduced. This information can affect surgery and reconstruction decisions (10). However, since hernias are incipient in athletes, that is, without ring dilatation or mild hernias and their content is invariably fat tissue, the surgery and reconstruction approaching techniques are not influenced by the type of hernia and they are the same for the three possible types of hernia. For this reason, the objective of this study was to define the ultrasound’s diagnostic accuracy for the diagnosis of inguinocrural hernias in a global way.
Athletic pubalgia and inguinocrural hernias

Fig. 6. A 34 years old male with an Indirect Inguinal Hernia in right side. It is a compound image. To the left, resting (A), and to the right, in Vasalva (B). The transducer is parallel to the long axis of the inguinal canal. In the image obtained while resting, the canal’s normal content is identified (thin arrow). After the Valsalva, the extraperitoneal fat extrusion can be detected (thick arrow). It can be noticed how the neck of the hernia (arrow) takes a lateral position to the inferior epigastric artery (AE).

Statistic Analysis
Ultrasound developing characteristics (sensitivity, specificity, positive predictive value and negative predictive value) in the diagnosis of inguinocrural region hernias were obtained as a whole when its findings were compared to those derived from the laparoscopic surgery and the external office control in those patients who were clinically followed.

RESULTS
A total of 800 inguinocrural regions were examined in 400 patients, all athletes (Table 1).

Of all these patients, 270 presented high pubalgia symptoms and 130 low pubalgia symptoms. None of the Ultrasounds performed was classified as non diagnostic. In 13 patients there were limitations of diagnostic capacity due to obesity and in 2 patients due to surgery scars, which generated sound attenuation spots. The Ultrasound showed the presence of hernias in 100 patients in 128 inguinocrural regions (16% of total regions, 25% of total patients; 100 unilateral, 28 bilateral). 104 patients underwent laparoscopic surgery. In all of them, the presence of hernia orifices was verified. None of the patients with positive ultrasound was found free from hernia at the moment of surgery. In 28 patients the defect was bilateral. From the total of hernias, 92 were direct, 36 indirect and 4 femoral. The universal characteristic of the hernias found and repaired was a hernia orifice without dilatation or with a minimum dilatation level. In addition, the extruded material through the hernia orifice was extraperitoneal fatty tissue. There were no intestinal loops in any of the cases. In the 4 patients who had a negative Ultrasound, the hernia was very small (Table 2).

When making the comparison with the clinical and surgery, the sensitivity of the method was of 96,96% and the specificity of a 100%. The positive predictive value and the negative predictive value were of 100% and 99, 4%, respectively.

DISCUSSION
In this retrospective series, the Ultrasound exam turned out to be a trustful method to establish the diagnosis of hernia in the inguinocrural region as the cause for pubalgia in athletes. This condition is a painful syn-
Fig. 8. A 29 years old male with a Direct Inguinal Hernia on the right side. It is a compound image. The transducer is parallel, but above the level of inguinal canal. On the examination while resting (A) there are no alteration registered. After the Valsalva (B) the extrusion of adipose tissue can be observed (arrows). Now, the hernia occupies a medial position to the inferior epigastric artery (small arrows) and, in addition, it is projected over them. Abbreviation: AI, Primitive Iliac Artery.

Fig. 9. Laparoscopic image of the same patient. The bulging that the hernia produces on the wall is evident and consists on extraperitoneal tissue (arrows). The iliac vessels occupy a lateral position (small arrow). Towards medial, suspensor bladder ligaments can be distinguished (thick arrow).

drome that can be caused by diverse entities. In the majority of the cases, the patient refers to low inguinal pain and in the daily practice- in athletes as well as in the general population- the diagnosis is established by the physical examination. Complementary diagnostic methods would then be limited to those cases in which the data from the physical examination is not concluding. There are multiple articles in the literature with information about the causes and the performance of different diagnosis methods that can be used in patients with inguinal pain.

Perhaps due to the invasiveness of the method, the herniography is becoming less used for the diagnosis of hernias, although the results obtained with it are very trustful and it had been considered the reference standard for a long time. There are several reports in the literature; in the series involving the population in general, hernias were detected in 27-40% of patients in the symptomatic side and in 6-18% in the asymptomatic side. However, it was not possible to document the presence of hernia in all those patients since the remission of symptoms prevented them from surgery in many cases. The presence of false negatives and false positives has been reported. False negatives were a consequence of small hernias where the contrast flocculated, or of those which were very small and their fat content prevented the contrast to pass to its interior or made that task difficult. False positives of the herniography can be explained by the inexistence of the hernia or by a so exiguous size that it is completely reduced with surgery under anesthetic.

Computer Tomography (CT) has proved to be a trustful method for the detection of hernias and its posterior classification, mostly in patients with doubtful or unspecific signs or symptomatology. However, it is necessary to consider CT as a method that is not easily adapted to the dynamic requirements (Valsalva) which evidence a big part of the hernias. In addition, it is not very useful for the diagnosis of other causes that can be the source of inguinal pain, especially in athletic patients.

There are several publications about the role of dynamic MR to localize the origin of pubalgia, in the general population as well as in athletes. Some of the studies were performed in patients with evident signs of inguinocrural hernia prior to surgery. In a recent study, in patients with athletic pubalgia evaluated with MR, just in 2% of them, the presence of a hernia was confirmed with surgery. Other studies place the hernias in percentages that vary from 30 to 82% as causes for the pain, or at least as concomitant findings in the surgery. This discrepancies set out a question that has not been elucidated yet. A part of the answer could be in the study population. When the cause of the pain cannot be clarified and it is persistent, hernias are usually the almost exclusive responsible agents. On the other hand, dynamic MR obtains better
results than ultrasound in the diagnosis of lesions that involve the articulation of pubis, in tendinous and muscle fibers lesions of the rectus anterior-abductors unit. Since this lesions, contrary to hernias, have better chances of remitting spontaneously or under conservative treatment, it is natural to conclude that hernias prevail in patients whose pain does not remit to or acquires a status of being more chronic (22, 23).

There are several studies that evaluate the validity of ultrasound in the diagnosis of hernias in patients with inguinal pain; most of them performed on general population, without being a group exclusively composed by athletes. The most recent report is based on a comparison of results between ultrasound and herniography in patients with pubalgia (7). The ultrasound performance showed very similar results to those of the present study, with a sensitivity of 95% and a specificity of a 100%. In this study, the ultrasound results were superior to the herniography results regarding sensitivity, being the specificity in

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**Table 1: Characteristics and athletic activities informed in the studied population.**

<table>
<thead>
<tr>
<th>Age distribution</th>
<th>Media age</th>
<th>Range</th>
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<tbody>
<tr>
<td></td>
<td>28</td>
<td>16-45</td>
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<table>
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<tr>
<th>Gender</th>
<th>Male</th>
<th>Female</th>
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<tr>
<td></td>
<td>94%</td>
<td>6%</td>
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<table>
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<tr>
<th>Informed activity</th>
<th>Professionals</th>
<th>Amateurs</th>
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<tbody>
<tr>
<td></td>
<td>30%</td>
<td>70%</td>
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</table>

<table>
<thead>
<tr>
<th>Practiced sport</th>
<th>Football</th>
<th>Rugby</th>
<th>Tennis</th>
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<tbody>
<tr>
<td></td>
<td>55%</td>
<td>30%</td>
<td>10%</td>
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<table>
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<tr>
<th>Miscellaneous</th>
<th>Basquetball</th>
<th>Skating</th>
<th>Cycling</th>
<th>Dancing</th>
<th>Gymnastics</th>
<th>Athletism</th>
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<td></td>
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**Table 2: Surgical findings in patients with hernia and negative ultrasound.**

<table>
<thead>
<tr>
<th>Patient number</th>
<th>Ultrasound result</th>
<th>Surgical findings</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Normal</td>
<td>Direct hernia orifice, non dilated, with extrusion of reducible fat tissue</td>
</tr>
<tr>
<td>2</td>
<td>Normal</td>
<td>Direct hernia orifice, discretely dilated, with extrusion of reducible fat tissue</td>
</tr>
<tr>
<td>3</td>
<td>Normal</td>
<td>Direct hernia orifice, moderately dilated, with extrusion of reducible fat tissue</td>
</tr>
<tr>
<td>4</td>
<td>Normal</td>
<td>Indirect hernia orifice, with extrusion of fat tissue</td>
</tr>
</tbody>
</table>

*Fig. 10. A 29 years old male with a Right Femoral Hernia. The image is compound. The patient is resting to the right (B) and in Valsalva to the left (A). In the study while resting the hernia is not visible (arrows). The hernia (thick arrows) can be observed after the Valsalva maneuver. It can be noticed the Femoral Vein (V) dilated following the progressive increase of intraabdominal pressure. Abbreviation: AF, Femoral Artery.*
both of them of a 100%. In other studies, researchers obtained sensitivity values that ranged from 86 to 100% and specificity values that ranged from 82 to 97% (24-26). Nevertheless, these studies were done some years ago and transducers of higher frequency were utilized, which have an influence to the detriment of the visualization detail of areas to explore.

Finally, in a report about 35 footballers in Australia –14 of them with chronic pubalgia–, 10 hernias were diagnosed by ultrasound and they were confirmed subsequently with surgery (27).

We do not have knowledge about publications with such a large number of patients with athletic pubalgia, whose positive ultrasound findings were confirmed by laparoscopy. A possible limitation of this report is that in patients with normal ultrasounds, the confirmation of absence of hernia pathology depends on the clinical follow-ups. Although check-ups of these patients in external office did not indicate otherwise, it could happen that in some patients the symptoms relapse and that they could be carriers of hidden hernia in the future.

CONCLUSION

Ultrasound is a studying technique with a high level of accuracy for the diagnosis of hernias in patients with athletic pubalgia, particularly in those cases in which the physical examination is not concluding or in those patients who suffer symptoms that do not remit. In spite of the fact that the sensitivity is high, the real value of ultrasound is shown when the hernia diagnosis is established, since the positive predictive value was of 100%. Therefore, and despite being an operator-dependent method, ultrasound should be considered as the first examination to perform in athletes with pubalgia, when it is necessary to rule out or confirm the presence of hernias in the inguinocrural region.

Bibliography


Fig. 11. Laparoscopic image of the same patient. The content of the hernia has been removed and the hernia orifice is exposed (arrows). Lateral to this orifice, it can be seen the femoral vascular package (small arrow).


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