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Testicular torsion: predictors of necrosis and balance of risks/benefits of a scrotal exploration without fasting

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Preditores de Necrose na Torção Testicular e Relação Risco/Benefício da Exploração
Cirúrgica Escrotal sem Jejum

*Testicular torsion: predictors of necrosis and balance of risks/benefits of a scrotal exploration
without fasting*

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Abstract

Introduction: Testicular torsion (TT) is a surgical emergency, and a delay in diagnosis or treatment can result in an inviable testicle. The therapeutic decision is made by the surgeon having considered all the clinical features. As an emergency, preoperative preparations such as fasting can be dismissed in an attempt to save the testicle. However, once the testicle is necrotic the patient does not benefit from an unnecessary emergency scrotal exploration and may be exposed to the risk of pulmonary aspiration if anaesthesia is done without appropriate preoperative fasting. The wisest decision, in this case, is to complete the fasting period and perform the surgery later. This study aims to measure the predictors of testicular necrosis and to correlate them with a balance of risks/benefits of emergent scrotal exploration without fasting.

Materials and Methods: The medical records of patients who were submitted to an emergency scrotal exploration in our hospital were retrospectively reviewed. We looked at age, clinical symptoms, physical examination, Colour Doppler Ultrasonography (CDUS) findings, operative details, pathology findings, timings of every procedure, last meal, and follow-up. To determine the predictors of testicular necrosis we performed Chi-Square test, receiver operating characteristic curve (ROC), t-Student test, Levene test and univariate and multivariate logistic regression analysis.

Results: One hundred boys were studied. In 16 boys an orchidectomy was performed; in 84 the testicle was kept in situ. 5 of these 84 boys later sustained testicular atrophy. Duration of pain >24 hours ($p<0.001$), degree of twisting >360° ($p=0.010$), heterogeneous echogenicity ($p=0.002$) and scrotal skin changes ($p=0.040$) were significantly associated with testicular necrosis. Duration of pain >24 hours and degree of twisting >360° of torsion showed a 93.8% and 92.3% sensitivity and 83.1% and 48.5% specificity, respectively, for testicular necrosis. Also, the triad of pain present for over 24 hours, no blood flow on CDUS and heterogeneous echogenicity was significantly associated with testicular necrosis ($p<0.001$).

Discussion: Duration of pain >24 hours, degree torsion >360°, heterogeneous echogenicity and scrotal skin changes on the physical examination positively predict the likelihood of testicular necrosis. Patients in our series with pain over 24 hours, no perfusion on CDUS and heterogenous testicular appearance would not have had their outcome altered by a delay in surgery to complete adequate preoperative fasting.

Conclusion: When considering a scrotal exploration on a patient with over 24 hours of pain, no perfusion on CDUS and heterogenous testicular echogenicity, one should consider delaying surgery to complete an adequate preoperative fasting.

Keywords: TESTICULAR TORSION, TESTICULAR NECROSIS, FASTING, SCROTAL EXPLORATION, NECROSIS PREDICTORS, PAEDIATRIC

Resumo

Introdução: A torção testicular é uma emergência cirúrgica, na qual um atraso no diagnóstico ou no tratamento pode resultar num testículo inviável. A decisão terapêutica é feita pelo cirurgião, tendo em consideração o quadro clínico. Sendo uma emergência, a preparação pré-operatória, como o período de jejum, pode ser ignorada de modo a salvar o testículo. Contudo, uma vez necrótico, o paciente não beneficia de uma exploração escrotal de emergência, correndo o risco de possível pneumonia de aspiração, se a indução anestésica for realizada sem um período de jejum pré-operatório apropriado. A decisão mais cautelosa, nesse cenário, seria completar o período de jejum e realizar a cirurgia mais tarde. O objetivo deste estudo é encontrar preditores de necrose testicular e correlacioná-los com o risco/benefício de uma exploração escrotal emergente sem jejum completo.

Materiais e Métodos: Os registos médicos dos pacientes submetidos a exploração escrotal de emergência, no nosso hospital, foram estudados retrospectivamente. Analisamos a idade, sintomas, exame objetivo, resultados da ecografia doppler testicular, detalhes da cirurgia, resultados anatomopatológicos, tempos de procedimentos, última refeição e seguimento pós-operatório. Recorremos ao Teste Qui-Quadrado, Curva de Característica de Operação do Receptor (ROC), Teste t-Student, Teste de Levene e à Regressão Logística com análise univariada e multivariada.

Resultados: Foram estudados 100 doentes. Em 16 doentes foi realizada uma orquidectomia e em 84 o testículo foi preservado. Destes 84 doentes, 5 sofreram, posteriormente, atrofia testicular. Duração da dor >24 horas ($p<0,001$), grau de torção > 360° ($p=0,010$), heterogeneidade na ecografia testicular ($p=0,002$) e alterações cutâneas do escroto ($p=0,040$) foram significativamente associadas à necrose testicular. A duração da dor >24 horas e grau de torção >360° mostraram 93,8% e 92,3% de sensibilidade e 83,1% e 48,5% de especificidade, respetivamente, na necrose testicular. Além disso, a tríade de dor >24 horas, ausência de perfusão testicular e presença de testículo heterogéneo à ecografia também foram significativamente relacionadas com necrose testicular ($p<0,001$).

Discussão: Duração da dor >24 horas, grau de torção >360°, heterogeneidade na ecografia testicular e alterações cutâneas do escroto predizem positivamente a necrose testicular. Na nossa série, doentes com dor >24 horas, ausência de perfusão testicular e testículo heterogéneo à ecografia não teriam outro resultado se a cirurgia fosse atrasada de modo a completar o período de jejum.

Conclusão: Ao considerar uma exploração escrotal emergente num doente com mais de 24 horas de dor, sem perfusão em doppler e um testículo com ecogenicidade heterogénea, deve-se considerar atrasar a cirurgia para completar um jejum pré-operatório completo.

Palavras-Chave: TORÇÃO TESTICULAR, NECROSE TESTICULAR, JEJUM, EXPLORAÇÃO CIRÚRGICA ESCROTAL, PREDITORES DE NECROSE, PEDIATRIA

List of Abbreviations

TT: Testicular Torsion

CDUS: Colour Doppler Ultrasonography

CHUC: Centro Hospitalar e Universitário de Coimbra

IQR: Interquartile Range

SPSS: Statistical Package for the Social Sciences

ROC: Receiver Operating Characteristic

AUC: Area Under the Curve

COVID-19: Coronavirus Disease 2019

Introduction

Testicular torsion (TT) is a surgical emergency which accounts for 5% to 25% of all cases of acute scrotum in paediatric patients. The age at presentation has a bimodal peak with each group characteristically presenting with a different type of torsion: in the perinatal period, an extravaginal torsion; in puberty, an intravaginal torsion. (1) TT is described as a sudden twist of the spermatic cord causing obstruction of the blood flow to the testis, which can lead to ischemia and ultimately to necrosis and testicular loss. (2)

Acute testicular pain associated with nausea and vomiting is the typical presentation of TT. At physical examination, an enlarged and tender testicle with erythematous overlying scrotal skin can be present. In addition, the affected testicle can assume an abnormal horizontal orientation, with a high-riding position, and absence of the cremasteric reflex. (3) Colour Doppler Ultrasonography (CDUS) is the standard imaging modality to help diagnose TT, because of its ability to provide information about the anatomy and perfusion. (1)

Avoiding irreversible changes, loss of testis, infertility, and psychological trauma implies a correct diagnosis and a well-timed surgery. A scrotal exploration is the gold standard treatment, associated with a bilateral orchidopexy or an orchidectomy with contralateral orchidopexy if the testicle is deemed unsalvageable. The decision to preserve or remove the testicle is made by the surgeon intraoperatively, based on the intraoperative evaluation of colour and blood flow after detorsion. (4) The literature describes other predictive factors of nonviability, including duration of symptoms, degree of torsion, and sonographic heterogeneous echogenicity. (4, 5)

If the detorsion of the affected testicle is performed within the first 6 hours, the salvage rate is over 90%, decreasing to 50% when beyond 12 hours. Testicular atrophy occurs by 6 to 8 hours and necrosis within 8 to 10 hours since the beginning of the torsion. When torsion is present for more than 24 hours, the salvage rate is less than 10%. (5, 6) One way of returning the blood flow to the testicle and shortening the time of ischemia is to perform a manual detorsion, as soon as possible. (7)

It is known that an early intervention is the mainstream of treatment, but it is important to have in mind the risks of an operation without correct preparation, such as preoperative fasting. In some cases, the evidence from the clinical examination and the CDUS may suggest that the testicle is already nonviable. However, patients may still be exposed to an unnecessary anaesthetic risk to avoid medicolegal disagreements that may arise from finding a necrotic testicle after having a delayed operation. (8, 9) If the surgeon was certain preoperatively that a testicle would not be salvageable and given the risk of emergency surgery without complete preoperative starving, the best approach would be to wait for a

completeness of the fasting time and delay the operation, since the result will be the same, an orchidectomy. It is important to take into consideration the risk of pulmonary aspiration during an emergency surgery when the 6 h of preoperative fasting is not performed. (10) Currently the clinical judgment of the surgeon is crucial to distinguish which management is best in each case and avoid unnecessary surgery or surgery with unnecessary risks.

The purpose of this study is to search for predictors of testicular necrosis and to try and guide the decision of the surgeon on the balance of risks and benefits of a scrotal exploration without fasting, based on evidence.

Material e Methods

This retrospective study was approved by the Ethics Committee of CHUC (process code OBS.SF.125.2021) and followed the principles of the Declaration of Helsinki, namely using deidentified and anonymised data for human medical research.

Based on the surgical records, we identified the last 100 boys (younger than 18 years old) who had an emergency scrotal exploration in the Department of Paediatric Surgery of the Hospital Pediátrico – CHUC.

The clinical data were obtained from the electronic medical record system used in our institution, and included age, clinical symptoms (duration of pain and vomiting), physical examination (scrotal erythema, transverse testicular orientation, testicular tenderness, high-riding testicle, enlarged testicle and cremasteric reflex); CDUS findings (blood flow, position of the testicular cord, testicular echogenicity – heterogeneous or homogeneous pattern, resistive index, size and symmetry between the two testicles); operative details (torsion of the cord, degrees of the torsion, perfusion, and type of surgery); pathological findings (necrotic or viable tissue); surgical outcome assessed at follow up appointments (atrophic or normal testicle); time of triage, time of the first consultation in the emergency department, time of the CDUS, time of manual detorsion, time of the last meal, and time of follow-up.

The success of the testicular detorsion was confirmed during the surgery when the spermatic cord was seen not twisted.

The following exclusion criteria were used: elective scrotal explorations, scrotal explorations performed for chronic pain, incomplete records (considered when medical records were more than 3 interquartile range [IQR] on the boxplot).

For statistical analysis, we used IBM Statistical Package for the Social Sciences (SPSS®), version 27. To describe the population of the study, we used descriptive statistics. The Chi-Square was applied to analyse relationships between categorical data. A receiver operating characteristic (ROC) curve was applied to calculate the sensitivity and specificity of the duration of pain and the degree of twisting of the spermatic cord and the predictive value of the different variables. The area under the curve (AUC) was considered statistically significant when $AUC > 0.80$. To compare the mean across two groups (testicular viability or necrosis) the t-Student test was used. The Levene test was also used to access the variance of a variable between two groups. Univariate and Multivariate logistic regression analysis were used to predict the change of status, between testicular viability and testicular necrosis. Statistical significance was considered at $p < 0.05$.

Results

In our department, between February 2019 and April 2021, 100 boys were submitted to a scrotal exploration for possible testicular torsion. Intraoperatively, the surgeon decided on the viability of the testicle and how to proceed. In 16 cases, the patient underwent an orchidectomy for an assumed nonviable testicle. This assumption was later verified as correct in all cases, with the histopathological results confirming necrosis of the removed testes. In the remaining 84 patients an orchidopexy was performed, attempting to preserve the testicle. Of those patients, 5 were deemed at follow up as having suffered testicular atrophy.

The mean age of the boys was 14 years (± 2.97 years). The mean duration of pain was 27 hours and 39 minutes (± 78 hours and 48 minutes) and was significantly longer for the patients who underwent an orchidectomy (105 hours) than those subjected to an orchidopexy (11 hours and 44 minutes), $p < 0.05$. The mean total duration of pain (since the beginning of pain to the operation room) was 31 hours and 50 minutes. For the viable testicle, this mean was 14 hours and 21 minutes, for the atrophic one it was 26 hours and 32 minutes, and for the necrotic testicle 111 hours and 16 minutes (which is equivalent to 4.6 days). From the triage to surgery, the mean wait time was 3 hours and 47 minutes. For those with necrotic testicles, the mean was 6 hours and 31 minutes, with atrophic testicles 3 hours and 58 minutes, and for viable ones 3 hours and 53 minutes. Those with orchidectomies did wait significantly longer than those with orchidopexies ($p < 0.05$).

The rate of success of the manual detorsion was 40.32%. The mean total duration of pain for the group where detorsion was not performed was 69 hours and 21 minutes. This group waited from the triage to surgery a meantime of 5 hours and 54 minutes. The mean duration of pain until detorsion was 6 hours and 45 minutes in the group with successful detorsion. From the triage to the manual detorsion, on the total of 62 boys where manual detorsion was executed, the mean wait time was 48 minutes.

The mean duration of fasting before surgery was 7 hours and 34 minutes. For those with necrotic testicle, it was 9 hours and 4 minutes, atrophic testicle was 8 hours and 11 minutes and for the viable testicle, 7 hours and 3 minutes.

Of the 21 patients for whom surgery did not change the outcome of testicular loss, 7 patients were exposed to surgery without preoperative fasting.

It was possible to identify for the necrotic group significant associations. The duration of pain > 24 hours ($p < 0.001$), degree of twisting $> 360^\circ$ ($p = 0.010$), heterogeneous echogenicity

on CDUS ($p=0.002$), and overlying skin changes on the physical examination (scrotal erythema) ($p=0.040$).

The ROC curve showed that the duration of pain >24 hours (AUC 0.884; with 95% confidence intervals: 0.798-0.970) would provide a 93.80% sensitivity and 83.10% specificity for prediction of testicular necrosis (Fig. 1). Additionally, a degree of twisting $>360^\circ$ (AUC 0.704; with 95% confidence intervals: 0.549-0.859) would give a 92.30% sensitivity and 48.50% specificity for testicular necrosis.

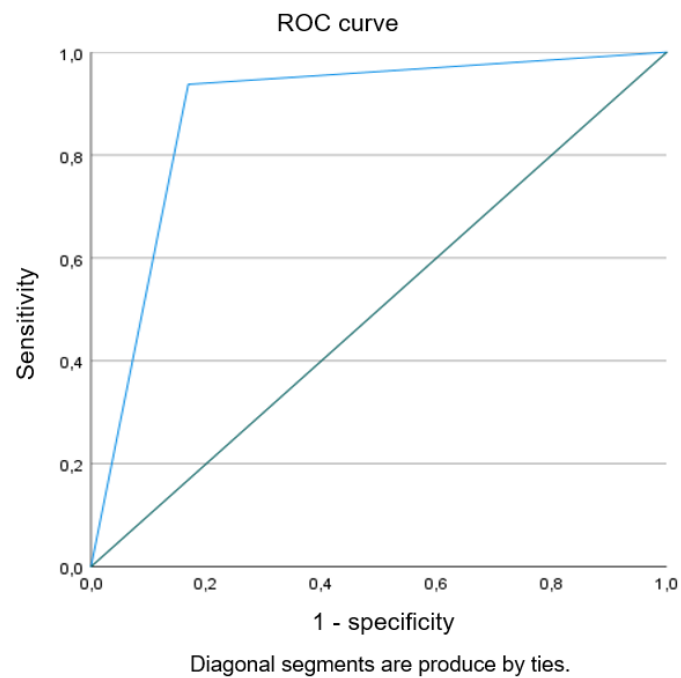


Figure 1. ROC curve for predicting testicular necrosis when the duration of pain is >24 hours.

The duration of preoperative fasting according to the duration of pain is in Table 1, assuming there is complete preoperative fasting when the duration of starvation is >6 hours.

Table 1. Time of fasting according to the duration of pain

| | Duration of pain | | | | | | |
|--|----------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| | <6h | [6-8h[| [8-12h[| [12-24h[| [24-48h[| [48-72h[| ≥72h |
| N patients according to duration of pain | 47 | 10 | 5 | 3 | 10 | 8 | 10 |
| N patients with known fasting status | 32 | 9 | 3 | 3 | 6 | 7 | 8 |
| Mean of fasting time | 06:37:11 | 06:00:13 | 13:43:20 | 08:31:00 | 05:35:20 | 07:29:26 | 11:21:07 |
| Minimum of fasting time | 00:27:00 | 03:58:00 | 03:00:00 | 05:30:00 | 01:12:00 | 02:32:00 | 03:15:00 |
| Maximum of fasting time | 14:45:00 | 07:00:00 | 21:15:00 | 13:43:00 | 09:50:00 | 12:00:00 | 22:54:00 |
| Performed fasting (N, N%^a, mean) | 17 (53%) 08:40:11 | 6 (67%) 06:24:10 | 2 (67%) 19:05:00 | 2 (67%) 10:01:30 | 3 (50%) 07:44:20 | 4 (57%) 09:51:15 | 5 (63%) 16:00:00 |
| Performed non fasting (N, N%^b, mean) | 15 (46%) 04:17:48 | 3 (33%) 05:12:20 | 1 (33%) 03:00:00 | 1 (33%) 05:30:00 | 3 (50%) 03:26:20 | 3 (43%) 04:20:20 | 3 (37%) 03:36:20 |

a. Percentage of boys from “N patients with known fasting status” who performed fasting, rounded to units.

b. Percentage of boys from “N patients with known fasting status” who did not performed fasting, rounded to units.

Testicular necrosis was found in 1 patient (33.33%) between 12-24 hours of pain, and 15 boys (60%) after 24 hours of pain (Fig. 2).

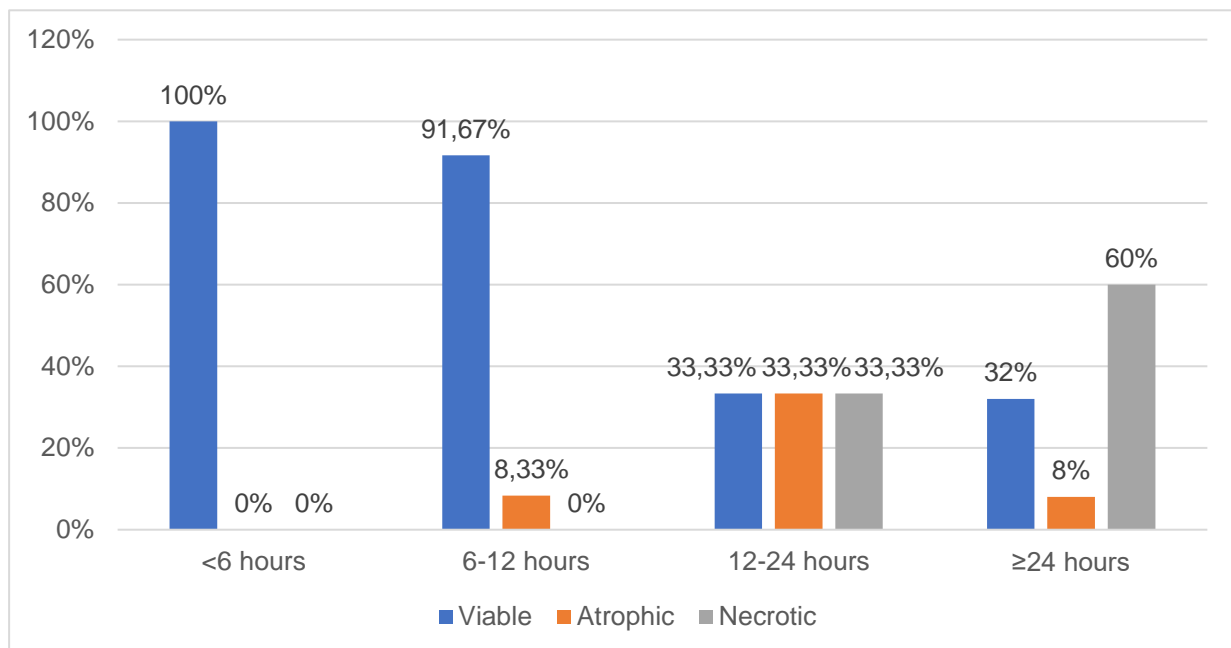


Figure 2. Testicular status according to the duration of pain.

On multivariate analysis of characteristics related to testicular necrosis, no isolated variable examined was predictive of necrosis.

However, in all cases presenting with pain over 24 hours of duration and in whom on CDUS there was no visible perfusion of the testicle which appeared heterogeneous – no testicle was salvageable. This pattern of three criteria (>24 hours of pain, heterogeneous echogenicity and absence of blood flow on CDUS) is significantly present in the necrotic group of patients, $p < 0.001$. If this criteria was used as a marker of irreversible damage and applied to the cases presenting without a complete starvation time, 2 patients could have been deemed safe to wait for completeness of their preoperative starvation time and would have been subjected to a surgery with less risks and without a change in their outcome.

There were 4 patients who had a heterogeneous testicle without blood flow on CDUS who kept their testicle. They had between 4 hours and 10 hours of pain.

Discussion

One of the purposes of this study was to find the predictors of testicular necrosis and we found that the duration of pain >24 hours, degree of twisting >360°, heterogeneous echogenicity, and skin changes on the physical examination were associated with testicular necrosis in this study. In addition to this, patients presenting with >24 hours of pain, heterogeneous echogenicity and absence of perfusion on CDUS invariably ended up with an inviable testis. The mean duration of pain of the patients who underwent an orchidopexy was 11 hours and 44 minutes while those who had an orchidectomy was 105 hours. These findings corroborate with what is reported in the literature - the salvage rate is 90-100% if the detorsion is performed within the first 6 hours of symptom onset, decreased to 50% when beyond 12 hours of pain and less than 10% when present more than 24 hours. (5, 6) This time must be reduced by raising general awareness about this emergency among the parents, schools, and young males.

However, the duration of pain is not the only factor affecting testicular viability. In our series, there were two patients, one with 6 hours and the other with 12 hours of pain, who had an orchidopexy and went on to sustain testicular atrophy; and one boy with 12 hours of pain who underwent an orchidectomy. The European Association of Urology Guidelines on Paediatric Urology advise that when the duration of pain is >24 hours the scrotal exploration may be performed as a semi-elective procedure. (11) However, in our study, 7 patients with testicular pain of >24 hours still had viable testes at surgery. This evidence must alert us to other variants that contribute to the outcome, such as the degree of torsion, thickness of the cord and the degree of bell clapper deformities. (12, 13)

Higher degrees of torsion are observed in patients with testicular necrosis who had an orchidectomy. Feng et al. confirmed that different degrees of testicular rotation are associated with testicular outcomes and describe a cut-off value of 530° of torsion with 61% sensitivity and 70% specificity for predicting non-salvageability. Also, they concluded with a multivariate analysis that testicular salvageability can be predicted by the duration of symptoms along with the degree of twisting. (11, 14) Those results agree with our outcomes where the duration of pain >24 hours and testicular rotation >360° gives a 93.8% and 92.3% of chance of testicular necrosis, respectively.

CDUS results can be a valuable adjunct in the management of TT patients. The heterogeneous echogenicity was found as a predictor of testicular necrosis in our study and in the available literature. Lian et al. also considered the features of CDUS that evoke this

pathology: complete or partial hypoechoic pattern at the beginning of the torsion followed by a heterogeneous or hyperechoic appearance, the image of twisted vessels, named “whirlpool” or “snail shell”, and absent, decreased, or inverted diastolic arterial flow on Doppler. (4) Also, heterogeneous echogenicity is predictive of the development of testicular atrophy by Lian et al., although, 21% of their patients who had homogeneous echogenicity eventually developed testicular atrophy. (4) These findings endorse the fact that heterogeneous echogenicity is a sign of decreased testicular perfusion causing ongoing necrosis.

TT can appear on physical examination with scrotal skin changes such as scrotal erythema. Previous studies showed that induration and erythema of the scrotal wall are valuable predictors of TT. These findings need to be searched for by every physician evaluating patients with testicular pain. Also, the absence of ipsilateral cremasteric reflex, nausea, and vomiting are other parameters that must be assessed in the clinical evaluation of these patients. They are significant adjuncts to diagnose TT successfully.(15)

In our series, patients presenting with >24 hours of pain, heterogeneous testicular echogenicity and absence of testicular perfusion on CDUS ended up with an inviable testis. In this scenario, the time required to save the testis and promote testicular perfusion is no longer significant, since the testicular viability is already unachievable. Patients without these three characteristics present may preserve testicular viability.

Table 2 summarizes the literature used in our study with predictive factors used in TT.

Table 2. Predictive factors in TT.

| Reference Country (year) | Type of study | N of data | Predictors searched | Results | Other useful information |
|-----------------------------------|----------------------------------|-----------|--------------------------------------|---|---|
| Cimador et al. Italy (2006) (12) | Original Article (prospective) | 15 | Predictors of testicular viability | No predictive factors were found for testicular viability | Salvageability was independent of the degree of torsion. |
| Srinivasan et al. USA (2010) (15) | Original Article (prospective) | 79 | Predictors of TT | Absence of ipsilateral cremasteric reflex (p<0.001) Nausea/vomiting (p<0.05) Scrotal skin changes (p<0.001) | |
| Ramachandra et al. USA (2014) (6) | Original Article (retrospective) | 114 | Predictors of testicular salvage | Duration of pain <6 hours (p<0.001) | |
| Lian et al. Singapore (2015) (4) | Original Article (retrospective) | 85 | Predictors of testicular atrophy | Duration of pain >1 day (p=0.004) Heterogeneous echogenicity on ultrasound (p=0.001) | Half of TT patients undergoing salvage surgery develop testicular atrophy. No testicle survived over 3 days of pain. Salvage rates are dismal when duration of symptoms >1 day. |
| Howe et al. USA (2017) (5) | Original Article (retrospective) | 81 | Predictors of testicular non-salvage | Increased time to intervention (p<0.01) Age (p=0.04) Degree of torsion (p=0.07) | Time to intervention of 8.5 hours provide 73% sensitivity and 80% specificity. % probability of non-salvage = 4 + 3(duration of pain) (p=<0.001) % probability of non-salvage = 7 + 0.05(degree of torsion) 1 out of 4 testes suffers atrophy after orchidopexy. 15 hours of symptoms and 860° of torsion estimate 50% of salvage rate. |
| Feng et al. China (2019) (14) | Original Article (retrospective) | 136 | Predictors of testicular non-salvage | Increased time of surgery (p<0.001) Degree of torsion >360° (p<0.001) | 530° of torsion provide 61% sensitivity and 70% specificity. |

| | | | | | |
|---------------------------------|----------------------------------|-----|-----------------------------------|--|---|
| Zvizdic et al. Qatar (2020) (2) | Original Article (retrospective) | 31 | Predictors of testicular salvage | Duration of symptoms (p<0.05) | |
| Nunes et al. Portugal (2022) | Original Article (retrospective) | 100 | Predictors of testicular necrosis | Duration of pain >24 hours (p<0.001) Degree of twisting >360° (p=0.010) Heterogeneous echogenicity (p=0.002) Scrotal skin changes (p=0.040) Triad criteria (>24 hours of pain, heterogeneous echogenicity and absence of blood flow on CDUS) (p<0.001) | Duration of pain >24 hours and degree of twisting >360° of torsion showed a 93.8% and 92.3% sensitivity and 83.1% and 48.5% specificity, respectively, for testicular necrosis. |

The main purpose of our study was to find predictors of an already necrotic testicle, to judge the risks and benefits of an emergent scrotal exploration. The mean of fasting for the necrotic testicle was 9 hours and 4 minutes. In this group, 5 patients underwent surgery without performing complete fasting (6 hours), and where the minimum of fasting was 2 hours and 32 minutes in a boy with 48 hours of testicular pain. Also, a boy with 120 hours of duration of pain, performed fasting of 3 hours and 30 minutes. Patients with [24-48 hours[of duration pain got a minimum of fasting lower than patients with [6-8 hours[, [8-12 hours[and [12-24 hours[when the salvage rate decreased 50% after 12 hours of testicular pain and is less than 10% when is over 24 hours. (5, 6) This result may be explained by the lack of scores and indecisions by the surgeon in patients with 24 hours of pain, so, in this situation, the surgeon assumed the best case scenario of preserving a testicle was still possible, although the salvage rate was predicted to be lower than 10%, and performed a scrotal exploration without complete fasting in an attempt to save an organ. Thus, the explorative scrotal surgery was, possibly, not used as a therapeutic procedure but as a diagnostic tool. Again, boys with [48-72 hours[of testicular pain had a minimum of fasting lower than [6-8 hours[, [8-12 hours[and [12-24 hours[when the salvage rate is lower than 10% (6) and >24 hours of pain is a predictor of testicular necrosis. Lastly, the group of patients with a duration of pain ≥72 hours, had 3 boys not completing the fasting and the minimum was 3 hours and 15 minutes, less than the groups of boys with [6-8 hours[. In this group with ≥72 hours of pain, with 10 boys, only 2 boys maintained a viable testicle. This fact must alert us to the importance of careful history taking plus a detailed physical examination having in mind every characteristic of testicular torsion. The boy with 72

hours of pain had a decreased blood flow with a heterogeneous testicle and twisting of 360° and the other boy with 120 hours had absence of blood flow but a homogenous testicle and, also, a twisting of 360°. None of them had all the criteria that we considered as predictors of necrosis, consequently, by our study, there was a possibility of testicular salvage. Interestingly, patients with [12-24 hours] had the higher minimum fasting value with a mean of fasting time higher than [24-48 hours] and [48-72 hours].

Although the multivariate analysis did not show a relationship between all variables, it makes sense to in each case consider all the predictors to stratify accurately the risk of testicular necrosis. Our study did show that in all cases when pain was over 24 hours long, without perfusion on CDUS and a heterogeneous appearance of the testicle, the testicle was not salvageable. And this seems to be a safe threshold to delay surgery until preoperative fasting is complete. Performing an emergent surgery without preoperative fasting on a boy with a necrotic testicle, may threaten the life of the boy for no change in outcome. Pulmonary aspiration can be an infrequent condition but is a potentially life-threatening complication of sedation. (16) To reduce this risk, fasting is recommended before a procedure, whenever possible. Fasting recommendations before elective anaesthesia are highly specific, authoritatively recommended and widely practised. In nonelective sedation for the urgent or emergent procedure, the opinion about needing a minimal period of fasting is divided. Many studies have tried to prove that fasting is unnecessary and should not delay emergent procedures, but with serious limitations such as not including “full stomach” patients and not clarifying if the decrease in pulmonary aspiration is because of the improvement of airway management or other anaesthetic techniques. (17, 18) Also, other studies consider “full stomach”, emergency surgery and anxiety risk factors for aspiration. (19) The current guidelines recommend 6 hours of fasting for solid food, 4 hours for breast milk, and 2 hours for clear liquids. (10) In elective surgeries, the family and the patient are informed about fasting before general anaesthesia, but it is known that 33% of the parents do not follow the fasting instructions and hide this information during preoperative verbal checks. (20) Apart from the medical consequences for the patient associated with failure to fast, there are also legal consequences. TT is the third most frequent diagnosis when it comes to malpractice claims between 12 – 17 years old. (21) Due to this, many centers surgically explore all cases of acute scrotum, despite the risks of anaesthesia, surgery and misdiagnosis.

Manual detorsion can be a timesaving manoeuvre from testicular ischemia and may be performed with no delay to the gold standard surgery. We know that in ischaemia every minute counts, and as we could see in our results, the mean time between diagnosis and treatment was 3 hours and 47 minutes. Testes which were not detorted had a mean total duration of pain of 69 hours and 21 minutes, while the total duration of pain until a successful manual detorsion

was 6 hours and 45 minutes. An enormous difference of time could be spared and minimize the duration of pain and testicular ischaemia of our patients. For the testes that were not detorted, the mean wait time from triage to surgery was 5 hours and 54 minutes; while the manual detorsion could be executed in a meantime of 48 minutes, saving more than 5 hours of testicular ischaemia and pain. The wait time can be made safer with a simple and non-invasive procedure, such as manual detorsion, applied along with preparations for surgical treatment. (7) In our series the success rate for the manual detorsion was 40.32%.

I propose to carry out a prospective study with standardized documentation of the history (duration of pain, character of pain – continuous or intermittent), nausea or vomiting, last meal and type of food), physical examination (scrotal skin changes [erythema], affected side, presence or absence of cremasteric reflex, testicular symmetry, tenderness, edema, position), time of manual detorsion, CDUS findings (blood flow, resistive index, symmetry, echogenicity and spermatic cord appearance), operative details (torsion, degree of torsion, perfusion) and follow-up (physical examination and CDUS findings) of boys presenting with acute scrotum. This prospective study would be used to observe medical practice and validate of these findings of our current study, hoping to provide even more accurate information, promote innovation and better health care.

Strengths and Limitations

Our study investigated predictors of testicular necrosis and proposed orientations to guide the management of TT with the appropriate preoperative fasting.

We worked with various analyses tests and tried to explore the data to the limit. The result of this research emphasizes findings in other studies, but it is unique in trying to look into the predictors of testicular necrosis and fasting to prevent exposure of patients to unnecessary risks.

Our study has several limitations, including the retrospective nature of the study, and inconsistency of the recorded information. The clinical data were obtained from the electronic medical record system, but some information was missing in some patients because the findings at history taking, physical examination, and CDUS are not standardized and its documentation is clinician dependent. Also, data from transferring hospitals were not always available.

Our sample is also small, and at times not enough to detect possible differences between the variables.

This study is taking into consideration data from a period before the pandemic of Coronavirus Disease 2019 (COVID-19), February 2019, and from the beginning of implementation of restrictions, recommendations, and norms, and until April 2021. Delays happened during this time with the obligation of performing preoperative COVID-19 tests or preparing the operating room and staff for an emergent surgery in a patient without known COVID-19 infection status. The speed with which clinicians were able to obtain COVID test results, specific hospital norms and staff familiarity with the protocolized procedures also changed throughout this period. However, this situation should not have interfered with the results regarding fasting time. Its impact would have been expected to happen on the wait times between the triage to surgery. Even though TT was still triaged as requiring immediate surgery, the safety of the patients and health care personnel also had to be taken into account. (22, 23)

It is important, for the future, to ensure a complete and standardized medical history, physical examination and CDUS findings documentation to be possible to prevent the recall bias and incomplete reports.

Conclusions

Duration of pain exceeding 24 hours, degree of torsion exceeding 360°, heterogeneous echogenicity on CDUS and scrotal skin changes on the physical examination are positively associated with testicular necrosis. In all patients in our series where pain was present for over 24 hours, there was no perfusion visible on CDUS and the testicle appeared heterogeneous – the outcome was invariably testicular loss. Using these factors as a predictor, the surgeon can provide more precise information to the patient and the parents, decreasing the stress and anxiety associated with the unknown. With all the variables taken into account it becomes easier to predict if the result will be an orchidectomy or an orchidopexy. Decreasing fasting time needs to be carefully considered in all situations. Predictors of necrosis are helpful in accessing the possibility of testicular salvage or its absence and in justifying a delay to the surgery.

Coming to the hospital at the first sign or symptoms of possible TT is still the most valuable strategy for preventing testicular necrosis and the parents and boys must be aware of this emergency.

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Appendix



REPÚBLICA
PORTUGUESA

SAÚDE

Visto/ À U.I.D.
para difusão

Dr. Nuno Deveza
SUA REFERÊNCIA
C.H.U.C. - EPE



SNS SERVIÇO NACIONAL
DE SAÚDE



Comissão de Ética para a Saúde

Exmo. Senhor
Dr. Nuno Deveza
Digmº Diretor Clínico do CHUC

SUA COMUNICAÇÃO DE

NOSSA REFERÊNCIA
N.º 367/CES

DATA
25-10-2021

Proc.Nº **OBS.SF.125-2021**

Estudo Observacional: **OBS.SF.125-2021** "PREDITORES DE NECROSE NA TORÇÃO TESTICULAR E RELAÇÃO RISCO/BENEFÍCIO DA EXPLORAÇÃO CIRÚRGICA ESCROTAL SEM JEIUM"

Entrada na UID: 21-06-2021

Entrada na CES: 16-09-2021

Investigador/a/es: Mafalda Fátima Gonçalves Nunes, Aluna do Mestrado Integrado em Medicina

Coordenador/a/es: Joana Alexandra de Almeida Lopes

Co-Investigador/a/es: Maria Francelina de Sousa Cruz Lopes

Promotor: Mafalda Fátima Gonçalves Nunes

Serviço de Realização: Serviço de Cirurgia Pediátrica do Hospital Pediátrico de Coimbra

Cumprir informar Vossa Ex.ª que a CES - Comissão de Ética para a Saúde do Centro Hospitalar e Universitário de Coimbra, reunida em 20 de Outubro de 2021, após reapreciação do projeto de investigação supra identificado, emitiu o seguinte parecer:

"A Comissão considera que se encontram respeitados os requisitos éticos adequados à realização do estudo, pelo que emite parecer favorável ao seu desenvolvimento no CHUC, com dispensa de consentimento informado".

Mais informa que a CES do CHUC deverá ser semestralmente atualizada em relação ao desenvolvimento dos estudos favoravelmente analisados e informada da data da conclusão dos mesmos, que deverá ser acompanhada de relatório final.

Com os melhores cumprimentos,

A Comissão de Ética para a Saúde do CHUC, E.P.E.

Prof. Doutora Margarida Silvestre
Presidente

CES do CHUC: Prof. Doutora Margarida Silvestre, Enf.º Adélio Tinoco Mendes, Dra. Cláudia Santos, Dra. Isabel Gomes, Dra. Isabel Ventura, Rev. Pe. Doutor Nuno dos Santos, Dr. Pedro Lopes, Doutora Teresa Lapa, Dra. Teresa Monteiro

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