

EFFECTS OF EXTRACORPOREAL SHOCK WAVE LITHOTRIPSY ON THE TESTES : AN EXPERIMENTAL STUDY

Bora KÜPELİ, M.D., Kemal SARICA*, M.D., Mehmet BUDAK**, M.D.,
Günay ALÇIĞIR***, M.D., Alim KOŞAR**, M.D., Kaan AYDOS**, M.D.

Gazi University, Faculty of Medicine, Department of Urology, Ankara, Turkey
Gaziantep University, Faculty of Medicine, Department of Urology*, Gaziantep, Turkey
Ankara University, Faculty of Medicine, Department of Urology**,
Ankara, Turkey
Ankara University, Veterinary Faculty, Department of Pathology***, Ankara, Turkey
Gazi Medical Journal 1999; 10 : 29-32

SUMMARY :

Purpose: To evaluate the histopathologic effects of High Energy Shock Waves (HESW) on the male reproductive system, an experimental study on male rats has been carried out. **Methods:** Animals were divided into three different groups and each group received 500, 1000, or 1500 shock waves, respectively. Following removal of the testes after 24 hours, 1 week, or 1 month post-procedure, gross morphologic and histopathologic examinations were performed. **Results:** Our results indicated that high energy shock waves may cause adverse effects on rat testes, some of which may be long lasting such as widespread fibrosis and dystrophic calcification. The degree of histopathologic alterations has been found to be dose and time dependent. **Conclusion:** Patients with lower ureteral or bladder stones should be treated carefully with extracorporeal shock wave lithotripsy because of the close localization of the testicle to the treatment focus of the lithotripter.

Key Words: Lithotripsy, Microscopy, Testis.

INTRODUCTION

Following its clinical introduction by Chaussy et al. in 1980, ESWL has proven to be a safe and effective alternative therapy in the non-invasive management of symptomatic urinary tract stones. However, it has been reported in a number of studies that high energy shock waves would cause some adverse effects on the function and morphology of parenchymatous organs (1, 2, 3). Although the main target of high energy shock waves is the stone located in different parts of the urinary tract, the surrounding tissue or organs are also subjected to trauma (4). In relation to this the male reproductive system may also be adversely affected in patients with lower ureteral or bladder stones. Likewise, treatment of symptomatic calculi

in children may reveal such side effects (5).

In this present study, in order to elucidate the adverse effects of shock wave therapy on the male reproductive system, the morphologic and histopathologic changes in rat testes following shock wave application have been evaluated.

MATERIALS AND METHOD

Twenty-seven 10-week-old male Wistar rats weighing 250-350 g were included in the study program, and the animals were randomly divided into three main groups according to the number of shock waves applied (500, 1000, 1500). The animals were fed with standard rat chow at normal room temperature. High energy shock wave

application was performed under ketamin HCL anesthesia (0.05 g/kg, im). All of the procedures were performed with Dornier MPL 9000 lithotripter and animals were placed onto the flexible membrane of the shock wave generator with careful localization of the testes at the F2 point of the system. Following shock wave application, 3 animals from each group were sacrificed and the treated testes were removed in sterile conditions after 24 hours, 1 week and 4 weeks. Removed specimens were placed in Bouine solution until histopathologic examination. Following gross macroscopic evaluation of all organs, sections obtained from treated testes were stained with Hematoxyline and Eosin and examined under light microscopy. All of these evaluations were performed by the same physician in order to avoid personal interpretation errors. Three animals were lost during the study for various reasons.

RESULTS

Evaluation of our gross macroscopic and light microscopic results revealed the following findings:

1. Early Findings (24 hours)

Hematoma formation was observed in all testes examined, regardless of the shock wave number applied. Light microscopic evaluation revealed widespread edema formation which was especially prominent in subtunical areas of the treated testes. Both interstitial and intertubular hemorrhage, the degree of which became evident with increasing number of shock waves, was seen in all sections evaluated. Although necrosis and degeneration of germ cells were determined in some seminiferous tubules, preservation of the basement membrane in these tubules was one of our main findings (Fig. 1).

2. Intermediate Findings (1 week)

Gross morphologic evaluation of the testes 1 week following shock wave application was normal with no evidence of hematoma formation, unlike the early findings. Additionally, a gradual decrease in both edema formation and intertubular hemorrhage were observed. However, degeneration of germ cells continued, with the appearance of some cellular debris and degenerated intracellular organelles, such as picnotic nucleus. Moreover, patchy tubular necrosis, expanding with the increasing number of shock waves, was also determined. Some degree of

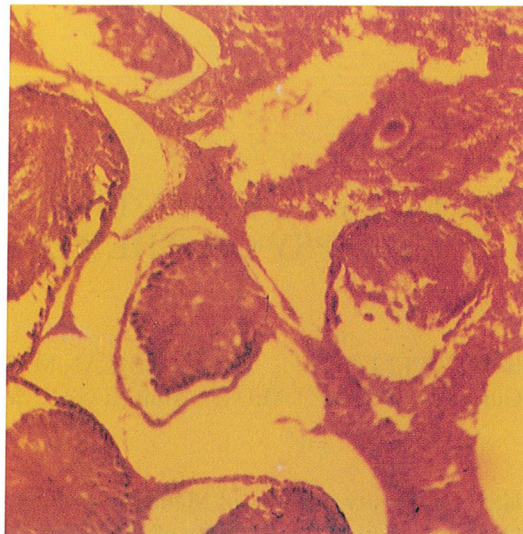


Fig. 1 : Evident edema formation with interstitial and intertubular hemorrhage (x 100).

connective tissue increase was another important finding (Fig 2).

3. Late findings (4 weeks)

Again, normal gross appearance of the treated testes was noted on macroscopic examination. The major light microscopic finding was the diffuse fibrosis seen almost in every section evaluated. Dystrophic calcification, resulting from the calcium deposition into the tubules which showed marked necrosis, could also be demonstrated. Despite the presence of spermatogenetic activity beginning from the intact basement membrane, the majority of the germ cells seemed degenerated and

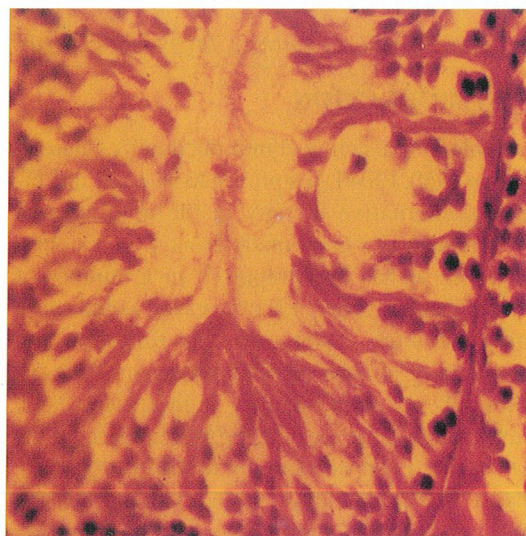


Fig. 2 : The appearance of degenerated intracellular organelles, such as picnotic nucleus, and some cellular debris (x 400).

a disorganization of the germinal epithelium was observed between fibrotic plaques (Fig. 3).

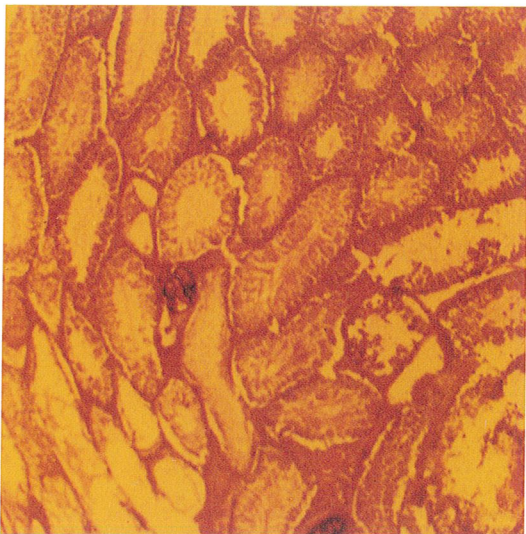


Fig. 3 : Irreversible morphologic changes, such as dystrophic calcification and widespread fibrosis between the tubules. (x 45)

DISCUSSION

Clinical introduction of high energy shock wave application in the noninvasive management of symptomatic urinary calculi has changed the treatment concepts of stone therapy. However, the rapid acceptance and adoption of the technique has been partly facilitated by the false perception that the system is entirely safe. Increasing experience in this field has shown that, apart from the treated organs such as renal parenchyma or ureteral wall, surrounding tissue or organs may also be adversely affected during shock wave application (2, 3, 4). In other words, injury to organ systems other than kidneys, ureter, etc. may also occur during ESWL. Though relatively uncommon (less than 1 % of patients), symptomatic and chemical pancreatitis, as well as chemical hepatitis, has been observed (3, 6). Additionally, pulmonary contusion, gastric and duodenal erosions, and hematochesia due to colonic mucosal damage have also been reported following shock wave application (3).

In relation to extra-urinary organ system injuries following ESWL, possible adverse effects of high energy shock waves on both male and female reproductive system have not been thoroughly evaluated (7). Taking the close localization of male reproductive system organs (testes) to the lower ureteral region and the bladder into account, a possible reflection of high energy

shock waves may occur onto these organs due to localization errors and close proximity. Again, focal diameter of some lithotripter systems may be wide enough to reflect shock waves to some extent especially in the child population. Pulmonary complications such as lower lobe contusion etc. led the physicians to protect the lungs especially in children with special shielding systems (8).

To evaluate the possible deteriorative side effects of high energy shock waves on the testes, an experimental study in rats with time and dose dependent base has been carried out. We applied lower doses of shock waves in contrast to normal clinical application, in order to mimic reflected shock waves during normal treatment conditions.

Evaluation of our results revealed acute gross morphologic changes such as hematoma formation in treated organs, which returned to normal in late follow-up. Although observation of subtubular edema formation and intertubular hemorrhage in the early phase of follow-up indicated prominent shock wave effect on testicular parenchyma, all of these light microscopic findings have been found to be reversible in late follow-up. However, some of these pathologic findings remained irreversible. Demonstration of severe morphologic changes in germ cells together with deteriorated spermatogenesis in seminiferous tubules during the 4th week examination led us to propose that at least some of these pathologies could be long-lasting. Again, widespread fibrosis observed in long-term follow-up examination has also supported our proposals.

Histopathologic alterations observed in our treated animal testes have indicated that testicles may be affected adversely to some extent during shock wave application. The close localization of the testicle to the treatment focus of the lithotripter and localization errors may cause such side effects in clinical practice. This condition is especially valid for patients with lower ureteral or bladder stones and that of children. Thus, physicians must be aware of these irreversible morphologic and histopathologic changes in the aforementioned patient groups. In experienced hands, with good localization and well protected extra-urinary organs such side effects can easily be avoided. However, we believe that further clinical and experimental studies including a larger series of patients with other definite parameters are certainly

needed in order to give more reliable data.

Correspondence to : Dr.Bora KÜPELİ
Beyazgül Sitesi A-1/21
Ümitköy
06530 ANKARA - TÜRKİYE
Phone : 312 - 214 10 80 / 6229
Fax: 312 - 212 90 21
e-mail: borakupeli@hotmail.com

REFERENCES

1. Brown RD, Preminger GM : Changing surgical aspects of urinary stone disease. *Surg Clin North Am* 1988; 68 : 1085-1104.
2. Gilbert BR, Riehle RA, Vaughan ED Jr : Extracorporeal shock wave lithotripsy and its effect on renal function. *J Urol* 1988; 139 : 482-485.
3. Krysiewicz S : Complications of renal extracorporeal shock wave lithotripsy reviewed. *Urol Radiol* 1992; 13 : 139-145.
4. Ackaert KSJW, Schröder FH : Effects of extracorporeal shock wave lithotripsy on renal tissue. *Urol Res* 1989; 17 : 3-7.
5. Ohmori K, Matsuda T, Horii Y, Yoshida O : Effects of shock waves on the male reproductive system. *Urol Int* 1993; 51 : 152-157.
6. Karawi MAA, Mehamed ARES, El-Etaibi KE, Abomelha MS, Seed RF : Extracorporeal shock wave lithotripsy induced erosions in upper gastrointestinal tract. *Urology* 1987; 30 : 224-227.
7. Chaussy C : In vitro and in vivo studies on biological systems. In : *Extracorporeal shock wave lithotripsy - Treatment concept, experimental research, and clinical application*. 2 nd. revised and enlarged edition. Karger, 1986; pp: 21-36.
8. Frick J, Köhle R, Kunit G : Experience with extracorporeal shock wave lithotripsy in children. *Eur Urol* 1988; 14 : 181-183.