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Original Article

Acute physical and psychological stress effects on visceral hypersensitivity in male rat: role of central nucleus of the amygdala

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ABSTRACT

Objective: The aim of this study was to investigate the effects of acute physical and psychological stress and temporary central nucleus of the amygdala (CeA) block on stress-induced visceral hypersensitivity.

Methods: Forty two male Wistar rats were used in this study. Animals were divided into 7 groups ($n = 6$); 1 – Control, 2 – physical stress, 3 – psychological stress, 4 – sham, 5 – lidocaine, 6 – lidocaine + physical stress and 7 – lidocaine + psychological stress. Stress induction was done using a communication box.

Results: Abdominal withdrawal reflex (AWR) score was monitored one hour after stress exposure. AWR score significantly heightened at 20, 40 and 60 mmHg in the psychological stress group compared with control ($p < 0.05$), while, it was almost unchanged in other groups. This score was strikingly decreased at 20, 40 and 60 mmHg in lidocaine + psychological stress group compared with psychological stress with no tangible response on physical stress. Total stool weight was significantly increased in psychological stress group compared with control (0.72 ± 0.15, 0.1 ± 0.06 g) ($p < 0.05$), but it did not change in physical stress compared to control group (0.16 ± 0.12, 0.1 ± 0.06 g) ($p < 0.05$). Concomitant use of lidocaine with stress followed the same results in psychological groups (0.18 ± 0.2, 0.72 ± 0.15 g) ($p < 0.05$), while it did not have any effect on physical stress group (0.25 ± 0.1, 0.16 ± 0.12 g) ($p < 0.05$).

Conclusions: Psychological stress could strongly affect visceral hypersensitivity. This effect is statistically comparable with physical stress. Temporary CeA block could also reduce visceral hypersensitivity post-acute psychological stress.

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Efeitos agudos do estresse físico e psicológico na hipersensibilidade visceral em rato macho: papel do núcleo central da amídala

Palavras-chave:
Reflexo de retirada abdominal
Amídala
Estresse físico
Estresse psicológico
Hipersensibilidade visceral

RESUMEN

Objetivo: O objetivo desse estudo foi investigar os efeitos do estresse físico e psicológico agudo e bloqueio temporário do núcleo central da amídala (CeA) na hipersensibilidade visceral induzida por estresse.

Métodos: Quarenta e dois ratos Wistar machos foram empregados nesse estudo. Os animais foram divididos em 7 grupos (n = 6): 1 – Controle, 2 – estresse físico, 3 – estresse psicológico, 4 – simulacro, 5 – lidocaína, 6 – lidocaína + estresse físico e 7 – lidocaína + estresse psicológico. A indução do estresse foi feita com o uso de uma caixa de comunicação.

Resultados: O escore do reflexo de retirada abdominal (RRA) foi monitorado uma hora depois da exposição ao estresse. O escore RRA aumentou significativamente a 20, 40 e 60 mmHg no grupo de estresse psicológico *versus* controle ($p < 0,05$), enquanto que praticamente permaneceu inalterado nos demais grupos. Esse escore diminuiu drasticamente a 20, 40 e 60 mmHg no grupo de lidocaína + estresse psicológico *versus* estresse psicológico, sem resposta tangível no estresse físico. O peso total das fezes aumentou significativamente no grupo de estresse psicológico *versus* controle ($0,72 \pm 0,15$, $0,1 \pm 0,06$ g) ($p < 0,05$), mas não houve mudança no grupo de estresse físico *versus* controle ($0,16 \pm 0,12$, $0,1 \pm 0,06$ g) ($p < 0,05$). O uso simultâneo da lidocaína com o estresse acompanhou os mesmos resultados nos grupos psicológicos ($0,18 \pm 0,2$, $0,72 \pm 0,15$ g) ($p < 0,05$), enquanto que não foi observado qualquer efeito no grupo de estresse físico ($0,25 \pm 0,1$, $0,16 \pm 0,12$ g) ($p < 0,05$).

Conclusões: O estresse psicológico pode afetar fortemente a hipersensibilidade visceral. Esse efeito é estatisticamente comparável com o estresse físico. Um bloqueio temporário do CeA também pode reduzir a hipersensibilidade visceral pós-estresse psicológico agudo.

Introduction

Visceral hypersensitivity is now a common hypothesis used to explain the painful symptoms in patients suffering from irritable bowel syndrome (IBS). IBS is a prevalent gastrointestinal disorder characterized by abdominal pain and bowel habit changes with unexplored etiology.[1] Almost 22% of the population experiences IBS symptoms.[2] Difficulty in diagnosis and inadequate good treatment together with high social and medical costs changed IBS into a social concern.[3,4]

Psychological and physical stressors have been identified as important factors in IBS pathophysiology.[5,6] Researchers have found a relationship between central pathways of stress and anxiety and peripheral mechanisms modulating gastrointestinal sensitivity. Amygdala, especially the central nucleus of amygdala (CeA), which has a pivotal role on this relationship; mainly affects endocrine and autonomic reply to stress and causes visceral hypersensitivity.[7] Visceral hypersensitivity is commonly examined via different forms among which communication box seems to be an agreeable tool for concomitant study of physiological and behavioral changes under psychological and physical stresses.[8]

However, to the best of our knowledge, this is the first study which focuses on rat visceral hypersensitivity post induction in the communication box environment. Therefore, the aim of the current study was to investigate the role of CeA block in visceral hypersensitivity response post communication box induced physical and psychological stress model in male rats.

Materials and methods

Animals

Forty two male Wistar rats (250–325 g) purchased from physiology department of Tehran University of Medical Sciences (TUMS). Animals were kept under standard conditions of 12-h:12-h light/dark cycle with unlimited access to the standard rat chow and water. All experiments were performed upon TUMS ethical committee approval between 8 am up to 3 pm every day.

Experimental protocol

Experiments were performed on seven equally assigned animal groups ($n = 6$) as per the following classification:

1. Control; animals placed in stress box 15 min without receiving electric foot shock.
2. Physical stress; animals placed in stress box and received 5 s electrical shock (2 mA), then 55 s rest for 15 min.
3. Psychological stress; animals placed in the safe compartments for 15 min without receiving foot shock and then received visual, auditory and olfactory sensation cues from the neighboring animal,
4. Sham; animals received bilateral microinjections of normal saline (0.5–1 μl) into central nucleus of the amygdala

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