ORIGINAL RESEARCH PAPER

Radiodiagnosis

UTILITY OF M-MODE IN DETECTION OF TYPE OF CATARACT

KEY WORDS: Cataract, B-mode, M-mode, mature, immature

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ABSTRACT

Purpose: In cataract, the lens becomes opaque due to deposition of reflective material beneath the lens capsule. M-mode can demonstrate a normal lens; axial-transverse length of lens; demonstrate presence of cataractous changes in a lens as evident from echogenic white lines within the lens and type of cataract- anterior or posterior capsular, subcapsular, nuclear, cortical, immature and mature cataract, calcified cataract depending on the location of white echogenic lines on M-mode.

Methods and Materials: B-mode and M-mode ultrasound of 30 patients of cataract were performed for detection and characterization of the type of cataract. On B-scan, cataract is seen as opacities in the sonolucent lens due to specific deposition of reflective material in the lens. On M-mode, various linear lines appear in various locations depending on the type of cataract. Depending on the location of white lines within the lens, mature, immature, cortical, subcapsular and nuclear cataract can be diagnosed.

Results: Out of 30 cases examined on M-mode and B-mode, 4 cases were of early subcapsular (13%), 4 cases were of advanced subcapsular (13%), 8 cases were of early immature (27%), 8 cases were of advanced immature (27%), 2 cases were of cortical (6.33%), 2 cases were of mature (6.33%) and 2 cases were nuclear (6.33%). Conclusion: M-mode was extremely useful in early detection of the type of cataract and characterization of cataract and could detect calcification within the lens.

INTRODUCTION:

A cataract is defined as progressive opacity or clouding of eye lens with loss of lens transparency, obstructing the passage of light to the retina due to changes in hydration and denaturation of proteins. There are irreversible structural changes in the orderly arrangement of fibres from which the lens is made, hence there is opacification of the internal focusing lens of the eye (crystalline lens). Morphologically cataract can be capsular (anterior capsular & posterior capsular), subcapsular (anterior subcapsular & posterior subcapsular), nuclear and cortical. [1] B mode is extremely useful in detecting cataractous changes in a lens. Normally lens appears sonolucent with echogenic anterior and posterior capsule. Cataractous changes are seen as echogenic areas within the sonolucent lens. [2,3] Depending on the type of cataract, echogenic areas are seen within the lens. M mode can also be utilized in detecting changes of cataract in the lens. It can also detect the type of cataract depending on the distribution of white lines within the lens.

Tables and Illustrations:

Table 1:

Type of Cataract	Number of cases (n=30)	Percentage
Early Subcapsular	4	13
Advanced Subcapsular	4	13
Early Immature	8	27
Advanced Immature	8	27
Cortical	2	6.33
Mature	2	6.33
Nuclear	2	6.33

Chart 1:

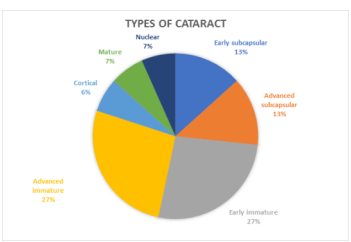

Table 2:

Type of cataract	No. of cases	Sensitivity	Specificity
B- mode	30	100%	100%
M-mode	30	100%	100%

Chart 2:

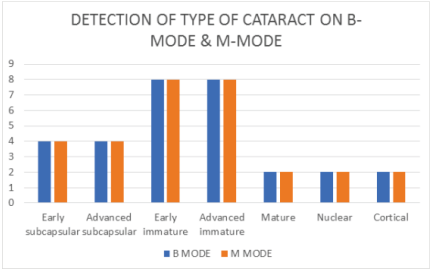

Table 3:

Type of Cataract	B mode	M mode
Early Subcapsular	Opacities seen beneath anterior and posterior capsule.	Various white lines are seen beneath white line of anterior and posterior capsule of lens.
Advanced Subcapsular	Increase in opacities seen beneath anterior and posterior capsule.	Increase in various white lines seen beneath white line of anterior and posterior capsule of lens.
Early Immature	Scattered opacities in lens separated by clear zones.	Multiple white lines are seen scattered in entire lens with intervening sonolucent areas.
Advanced Immature	Scattered opacities in entire lens increase with reduced intervening sonolucent areas.	Increase in multiple white lines scattered in entire lens with reduced intervening sonolucent areas.
Cortical	Thickening of anterior and posterior capsule.	Increase in intensity and thickness of anterior and posterior capsule of lens.
Mature	Entire lens appear opaque and echogenic.	Various white lines are seen traversing the entire lens with no clear space in between the lines.
Nuclear	Central portion of lens appears opaque/echogenic.	Multiple white lines are seen in the central portion of cataract.

Image 1:

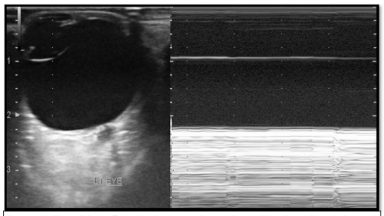

Image 1: Normal lens. B-mode shows sonolucent lens with echogenic anterior and posterior capsule. M-mode shows echogenic white lines at level of anterior and posterior capsule with no white lines within the lens.

Image 2:

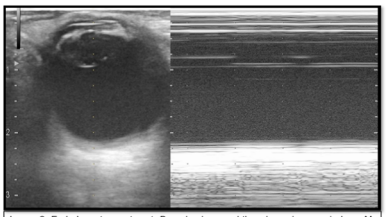

Image 2: Early Immature cataract. B-mode shows subtle echogenic areas in lens. M-mode shows echogenic white lines scattered in entire lens with intervening sonolucent areas.

Image 3:

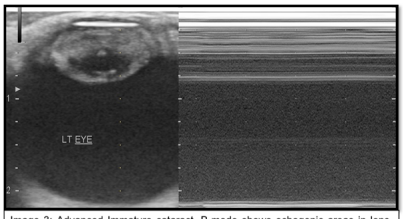

Image 3: Advanced Immature cataract. B-mode shows echogenic areas in lens, more beneath anterior capsule. M-mode shows multiple echogenic white lines scattered in entire lens, more beneath anterior capsule.

Image 4:

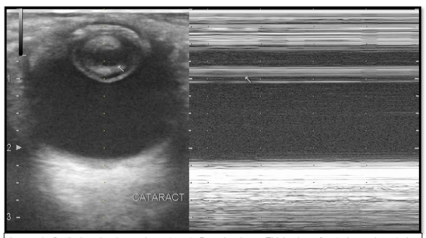

Image 4: Cortical and subcapsular cataract. B-mode shows Thickening of anterior and posterior capsule with echogenic areas beneath anterior and posterior capsule . M-mode shows Increase in intensity and thickness of anterior and posterior capsule of lens with echogenic white lines beneath anterior and posterior capsule

Image 5:

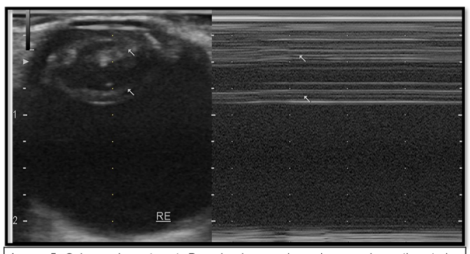

Image 5: Subcapsular cataract. B-mode shows echogenic areas beneath anterior and posterior capsule . M-mode shows echogenic white lines beneath anterior and posterior capsule

Image 6:

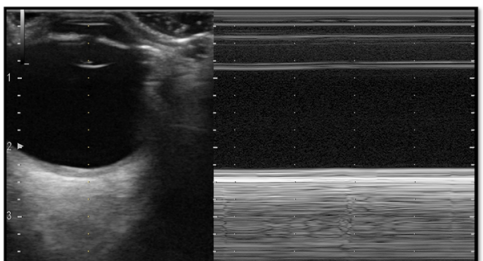

Image 6: Early Anterior and posterior subcapsular cataract. B-mode shows few echogenic areas beneath anterior and posterior capsule . M-mode shows few echogenic white lines beneath anterior and posterior capsule. These changes are more appreciated on M-mode.

Image 7:

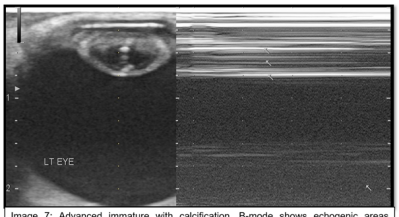

Image 7: Advanced immature with calcification. B-mode shows echogenic areas beneath anterior and posterior capsule and a small echo reflective calcific focus in the centre. M-mode shows echogenic white lines beneath anterior and posterior capsule. Calcific focus is seen as highly echogenic and intense white line.

Image 8:

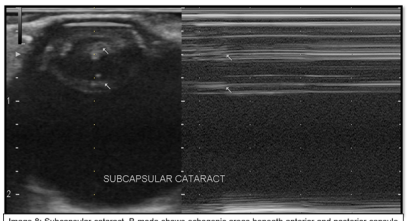

Image 8: Subcapsular cataract. B-mode shows echogenic areas beneath anterior and posterior capsule . M-mode shows echogenic white lines beneath anterior and posterior capsule

DISCUSSION:

A, B & M are the various ultrasound modes. Different modes are useful in examination of various body parts and vascular system. M mode (motion mode), time motion (TM mode) is the display of one-dimensional image used for analysing mainly moving body parts like adult and foetal heart.This is done by recording the amplitude and rate of motion in real-time by measuring distance of object from the transducer at a given moment.The single sound beam is transmitted and reflected echoes are displayed as dots of varying intensity creating lines across the screen.It is a diagnostic ultrasound presentation of the temporal changes in echoes in which the depth of echoes producing interfaces are displayed along an axis with time (T) and 2nd axis, motion (M) of the interfaces towards and away from transducer is displayed.M Mode gives excellent temporal resolution of motion patterns allowing evaluation of the function of heart valves and cardiac chambers anatomy along a single line through the patient is represented along M mode technique. It does not require a sweep through many ultrasound beams.X axis of m mode represents time while y axis represents deflector depth.[4,5,6]

Cataract can be senile (age-related) affecting people over 60 years of age, seen mainly in patients with diabetes, toxic (due to long-term exposure to systemic or topical steroids), post-traumatic, post-radiation exposure and congenital. [7] Age-related cataract mainly involves the nucleus of the lens. Toxic cataracts are usually posterior subcapsular. Capsular cataracts affect the capsule of the lens, cortical affects the cortex of the lens, lenticular cataract affects the lens but not its capsule. Complicated cataracts are secondary cataracts. Mature cataracts cause opacity and swelling of the entire lens, while immature cataract in which lens is slightly opaque and cortex is clear. A pre-senile cataract is a subcapsular cataract affecting population below 40 years of age. In a hyper mature cataract, content becomes solid and shrunken making the entire lens capsule wrinkled. Lamellar cataract affects certain layers and nucleus of the lens. Nuclear cataract affects the central portion of the lens. A zonular cataract is a cataract with opacity limited to certain layers of the lens. A posterior subcapsular cataract is between posterior capsule and cortex- also called a posterior cortical/ posterior subcortical cataract. It is common in young patients, diabetics, and patients using the steroid for the long-term. It diminishes near vision before distant vision. Anterior capsular cataract affects anterior lens capsule and be either of congenital origin or due to a perforating corneal ulcer. Bipolar cataract affects both anterior and posterior poles of the lens. A cortical cataract affects the cortex of the lens. The opacity begins as isolated dots or clusters of spokes forming cuneiform or subcapsular type of cataract, which eventually spread

through entire cortex. A cuneiform cataract is an age-related cataract, characterized by opacities within the periphery of the cortex of the lens in a radial manner like spokes on a wheel. [1] Cataract extraction can be extracapsular (ECCE) or intracapsular (ICCE). In ECCE, the anterior capsule is excised, the lens nucleus is removed and residual equatorial cortex is aspirated. The posterior capsule is intact and may be polished. In ICCE, the entire lens with its capsule is removed, thus not widely used technique. Though M-Mode is useful for moving objects like heart and diaphragm, it can be used for demonstrating the presence of cataract and type of cataract. The soft tissues do not move and hence give the linear appearance on M-mode, as the echoes do not change with time. A normal lens has an anterior capsule and posterior capsule with a clear sonolucent lens in between. Hence, on M-mode, the lens is seen as an anterior and posterior bright line with echo lucent space in between. In cataract, the lens becomes opaque due to deposition of reflective material beneath the lens capsule. Depending on the type of cataract, these reflective materials can be anterior capsular, posterior capsular, subcapsular, cortical, nuclear or affecting entire lens. [1]

On B-scan, an immature cataract is seen as scattered opacities separated by clear zones. In a mature cataract, the entire lens is seen as opaque and dens structure. [3] Due to specific deposition of reflective material in the lens, on M-mode, various linear lines appear in various locations depending on the type of cataract. In anterior and posterior capsular cataract, the intensity and thickness of anterior and posterior capsule of the lens increase on M-mode. In anterior and posterior subcapsular cataract, various white lines are seen beneath the white line of the anterior and posterior capsule of the lens, respectively. In nuclear cataract, multiple white lines are seen in the central portion of cataract. In a mature cataract, the entire lens appears opaque and various white lines are seen traversing the entire lens with no clear space in between the lines. Calcified foci within the lens show increased the reflectivity of the lines. Thus, M-mode is extremely useful in demonstrating: a) A normal lens; b) Axial-transverse length of lens; c) Demonstrating presence of cataractous changes in a lens as evident from echogenic white lines within the lens and d) Type of cataract- anterior or posterior capsular, subcapsular, nuclear, cortical, immature and mature cataract, calcified cataract depending on the location of white echogenic lines on M-mode. We can detect changes in the posterior segments like vitreous haemorrhage, vitreous floaters, vitreous membrane, posterior vitreous detachment and retinal detachment. On B-mode, the normal vitreous is sonolucent. Hence, on M-mode, there are no white lines between the posterior capsule of a lens and retina. In the presence of vitreous pathologies, white lines can be demonstrated in the vitreous region on M-mode.

RESULTS:

Out of 30 cases examined on M-mode and B-mode, 4 cases were of early subcapsular (13%), 4 cases were of advanced subcapsular (13%), 8 cases were of early immature (27%), 8 cases were of advanced immature (27%), 2 cases were of cortical (6.33%), 2 cases were of mature (6.33%) and 2 cases were nuclear (6.33%). Sensitivity and specificity on M-mode in the detection of the type of cataract was 100%. Both B-mode and M-mode could detect and characterize type of cataract. M-mode is extremely useful in detecting early subcapsular and early immature cataracts. Multiple white lines can be seen beneath the capsule in early subcapsular cataracts on M-mode. Multiple white lines can be seen in the entire lens with intervening sonolucent areas in early immature cataract on M-mode. These changes may not be well appreciated on B-mode.

CONCLUSION:

M-mode was extremely useful in the detection of the type of cataract and characterization of cataract and could detect calcification within the lens.

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