LaparoscopicCholecystectomy forAcuteCholecystitisbeyond theConventionalSafetyPeriodProceeded byUltrasonicEnergy Feasibility andOutcome

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Background: Timingoflaparoscopiccholecystectomyforacutecholecystitis(fromthe onsetofsymptoms)isrelatedtothedegreeofoperativedifficulty,increasessubstantiallyover time.Theappropriatetimingforearlylaparoscopiccholecystectomy inthetreatmentofacute cholecystitisremainscontroversial.However,nodefinitiveadvantagestoinitialconservative managementanddelayedlaparoscopicsurgeryinpatients suitableforsurgery.

Patients&metltods:30laparoscopiccholecystectomiesweretriedforacutegallbladder disease beyondtheconventionalcodedtimeof72hoursfromtheonsetofsymptomsupto5 weekslater. Ultra-sonicenergydevices(HarmonicScalpelandLigasure)weretheenergizer toolsforsurgicaldissection.Intra-operativedifficulties&complications,shifttoother procedures,lengthofoperations&post-operativehospitalstayand1monthfollowupfor potentialcomplicationswereassessedforfeasibilityand outcome.

Results:28ofthe30(93.33%) laparoscopiccholecystectomiesweresuccessfullycompleted. 2cases (6.67%)wereshiftedintoanother procedure.

Someintra-operativedifficultiesinsomecaseswereencounteredintheformofvariable densityofomentalandotherstructuresadhesionswithdifficultseparation(n:28,100%), difficultyingraspinggallbladderfundus(n: 7, 25%),difficultdissectionatCalottriangle (n:13,46.43%),cysticduct&arteryidentification,isolationandclipping(n:13,43.33%), difficultdissectionofgallbladderoffitsliverbed(n:9,32.1%)anddifficultextractionofthe gallbladder(n:3,10.7%).Nointra-operativecomplicationsweremet.Thelengthofoperations rangedbetween100-130Min.Withameanof115Min.Thelengthofpost-operativestay rangedbetween1-2dayswithameanof1.5days.Post-operativecomplicationscomprised2 cases(7.1%).Onewithbiliaryleakage(Clavien-Deinogradingsystem2b)andtheotherhad asuperficialsurgicalsiteinfectionattheumbilicalincision(Clavien-Deinogradingsystem]).

Conclusion: Laparoscopiccholecystectomy foracute gallbladder disease beyond the conventionalcodedtimeof72hoursfromtheonsetofsymptomsusingultra-sonicenergydevices forsurgicaldissectionbearsahighthresholdofsafety&feasibility withanexcellentoutcome incertainpatients,thisismainlyevidentwhentheoperatorisanexperiencedlaparoscopic surgeoninahighlytechnologically equippedlaparoscopiccenter.

Keywords:Acutecholecystitis,laparoscopiccholecystectomy,ultra-sonicenergydevices.

Introduction:

Cholecystitisis the most prevalent surgical condition affecting populations m industrializedcountries.[1]Gallstones constituteasignificant healthproblemin developedsocieties,affecting10%-15%ofthe adultpopulation.2Of.allcholecystectomies, 10-30%ispresentedintheacutesetting.This ismostcommonly(90o/o-95%)obstructivein naturefromimpactionofastoneinHartman pouchorcysticduct.[3]

The appropriate timing for early

laparoscopiccholecystectomyinthe treatment ofacutecholecystitisremainscontroversial and the timing of surgery has varied in studies.4 Thedegreeofoperativedifficulty increasessubstantiallyovertime inacute cholecystitisand surgeons have typically used72hoursasanarbitrarycutoffindegree ofdifficulty ofthedissection. Generally,in the first 48 to 72 hours of symptoms the tissue planes are edematous but structures areidentifiableandthetissueplanesseparate withoutmuchdifficulty.After72hours,the tissues become more friable and separate less well, the important structures are less likelytobe seenwell,andthere isoftenmore obscurative bleeding.Forthisreason,it is importanttoconsideroperatingearlyinacute cholecystitisifthepatientdoesnotrespondto conservativemeasuresandantibiotictherapy after24hoursofobservation.5

Electro-cauteryremains themain energy form used during laparoscopic dissection. However, because of its documented risks, especially those related to visceral injury, search for alternative forms of energy that can beused inlaparoscopic dissection and even coagulating and sealing vessels and ductsbeganveryearlyduringtheevolution of laparoscopic cholecystectomy itself. Ultrasonic energy dissection was reported using different devices and terminology [Harmonic scalpel, ultrasonic shears, ultrasonically activated coagulating shears (UACS),UltracisionHarmonicShears(UHS), Cavitron Ultrasonic Surgical Aspirator (CUSA)and [Liga-Sure].6 The Harmonic Scalpelistheleading ultrasoniccuttingand coagulatingsurgicaldevice,offeringsurgeons important benefitsincluding: Minimal lateral thermal tissue damage, minimal charring and desiccation. Harmonic Scalpel technology reduces the need for ligatures with simultaneous cutting and coagulation; moreoverthereisnotelectricitytoorthrough thepatient.7 Harmonic Scalpelhasagreater precisionnearvitalstructuresanditproduces minimal smoke with improved visibility inthesurgical field.Inretrospective serieslaparoscopic cholecystectomy performed with Harmonic Scalpel was demonstrated feasibleandeffectivewithminimaloperating timeand blood loss;itwasreported alsoa lowconversionrate.8

Patientandmethods:

Itisaprospectivestudythatwasconducted in the Department of Surgery, Faculty of Medicine, FayoumUniversity from the periodofAugust 2013tillOctober 2014.A totalof30patientsofacutecholecystitis,72 hours frombeginning ofthesymptoms up to5weekslaterwereincluded inthestudy. Ofthese30patients,5caseswereaccidently diagnosedintra-operativelyashavingarecent acute attack during elective laparoscopic cholecystectomy for a chronic gallbladder stonedisease,accurateretrospectiveanalysis oftheirhistorydemonstrated theappearance of acute symptoms more than 72 hoursof theoperation.Therestwerepre-operatively diagnosedasacutecholecystitis.

Acute cholecystitiswas established baseduponthe RevisedTokyo Guidelines Diagnostic CriteriaforAcuteCholecystitis, asfollows:-

A.Localsignsofinflammation,etc.: (1) Murphy'ssign, (2)rightupperquadrantmass/ pain/tenderness.

B.Systemic signsof inflammation, etc.: (1) Fever,(2) elevatedC-Reactive Protein, (3)abnormalWhiteBloodCellcount.

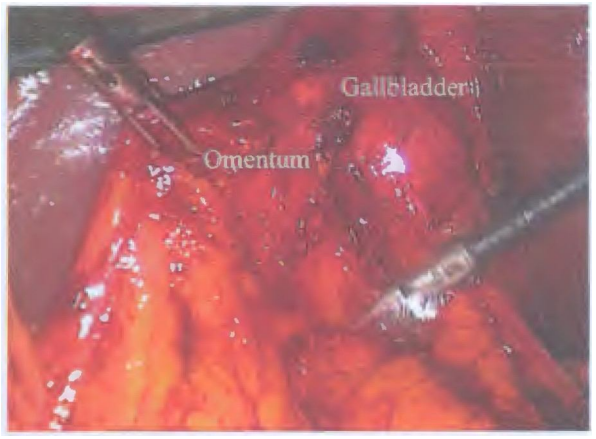
C. Imaging findings: Imaging findings characteristic of acute cholecystitis, basically:-abdominal ultra-sonography; whichwasenoughforimagingdiagnosis.

Radiologyultra-sonographyresults were defined as positive for acute cholecystitisif they demonstrated cholelithiasis(in the calculousvariety) plus any one of the followingsecondaryfindings:Wall thickeninggreaterthan3mm,pericholecysticfluid ,asonographic Murphy'ssign,astriated gallbladder wall, mucosal sloughing, intramuralgas,sludgewithinthegallbladder andgallbladder dilatation ofgreaterthan 5 emintransversediameter.

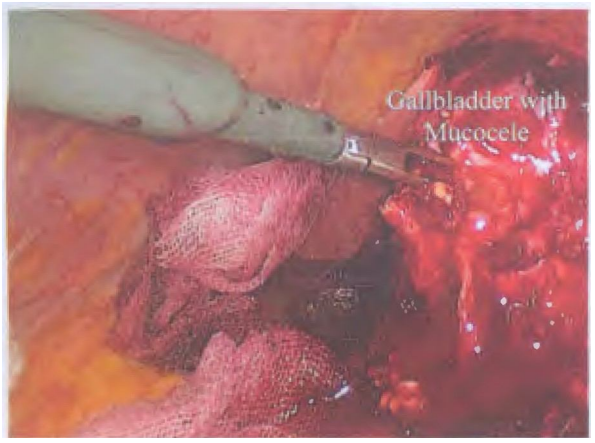
DefiniteDiagnosis:

(I) OneiteminA+oneiteminBwere positive.

Figure (1):An intra-operative picture showing severelyinflamedgallbladderwith omental&duodenaladhesions.



Figure(2):An intra-operative picture showingseverely inflamedgallbladderwith omental&stomachadhesions.



Figure(3):Anintra-operativepictureshowing adistendedgallbladderwithmucocele.

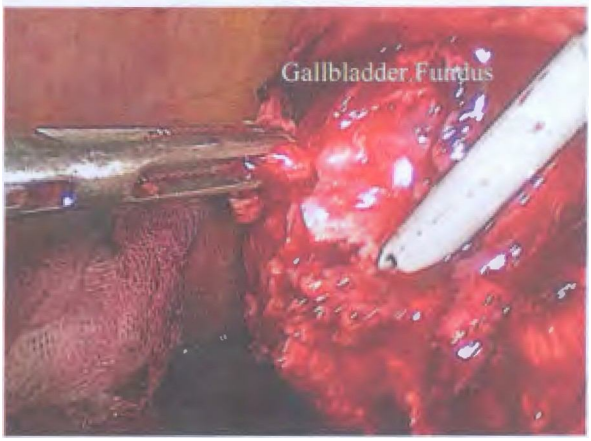


Figure (4): An intra-operative picture showingahole madeinthefundusofa distendedgallbladderaimingatsuctionofits contentsforemptying.

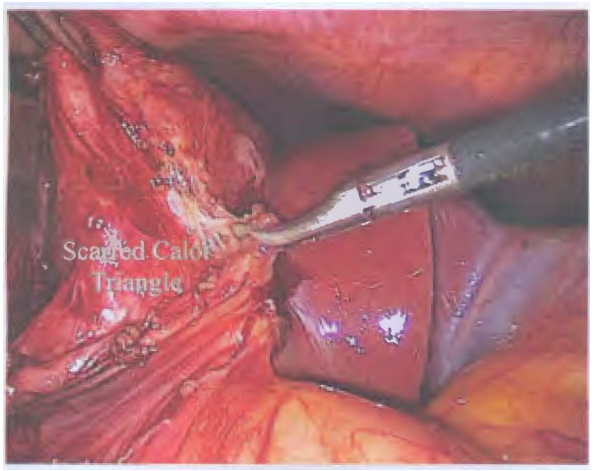


Figure (5): An intra-operative picture showingdissectionatsca"edCalottriangle.

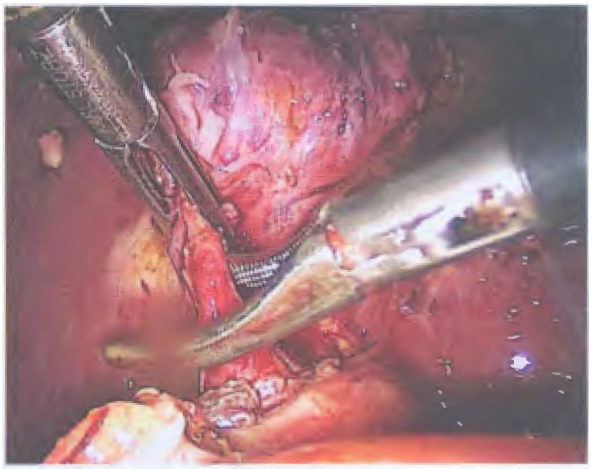


Figure (6): An intra-operative picture showingskeletonizedcysticduct.

(2)Cconfirmsthediagnosiswhenacute cholecystitiswassuspectedclinically.

Other acute abdominal diseases were excludedthroughtheroutine laboratory and imagingworkup,as appropriateforevery case.

Figure (7): An intra-operative picture showingskeletonizedcysticartery.

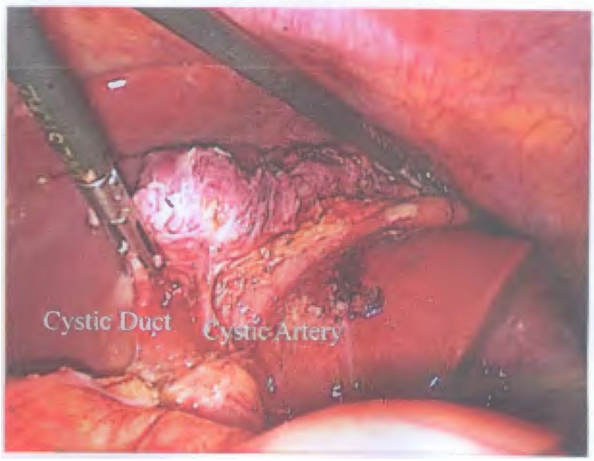


Figure (8): An intra-operative picture showingCriticalViewofSafety.

Figure(9):Flowchartofstudy

Weexcludedpatientsabove60yearsage, choledocholithiasiswith abdominal ultra-sonography,havingco-morbidconditionsout ofASAI&IIoritsacutecholecystitiswas secondarytoasystematicillness,pregnancy/ historyofmissedperiodsinpremenopausal females,Jaundice,cholangitis,andthosewho refusedsurgery.

Awritteninformedconsentwastakenfrom allpatients. Ethicalapprovalwasobtained fromtheethicalscientificcommitteeofthe FacultyofMedicine,FayoumUniversity.

Pre-operatively all admitted patients werere-evaluatedbyadetailed history, thoroughexaminationandrevision oftheir investigations.Patientswithapresentacute attackwerekeptonnilperoral,intra-venous fluids,parentralantibiotics andparentral analgesia;asappropriate.

Statisticalanalysis:

Categorical variableswere quoted as thenumber andpercentage.Quantitative variableswere summarizedastherangeand mean.

Surgicaltechnique:

Laparoscopic cholecystectomy was doneundergeneralanesthesiawithmuscle relaxants and endo-tracheal intubation. Patientswereputsupineontheoperatingtable withroutineapplicationofcrepebandages asa mechanicalanti-thromboticmaneuver. Routineprophylacticantibiotic(oneofthe3th generationcephalosporins)wasadministered with inductionofanesthesiaafterperforming the sensitivitytest at ward.Array ofthe operators andequipmentsentailed that,thesurgeonstoodtotheleftofthepatient.The firstassistantstoodtothepatient'sright.A laparoscopic videocameraoperatorstands

to theleftsideof thesurgeon.The video monitorwasplaced on the patient's right at the level of his shoulder. Insufflation was commencedby an open technique. Standardfourporttechniquewasusedforthe laparoscopic cholecystectomy. Ultra-sonic energydeviceswerethetoolsofdissection, principally HARMONIC SCALPEL® (Ethicon Endo-Surgery of Johnson &Johnson,Inc.,Cincinnati,Ohio,USA)a nd LIGASURE™ (Covidien, Inc., Mansfield, Massachusetts, USA). Conventional techniqueforlaparoscopiccholecystectomy was proceededwithout the use of either intra-operative cholangiography or ultra-sonography. Intra-operative modifications were adopted according to operative circumstancesandsurgeon'spreferenceeg. Gallbladder decompression. An abdominal drainwasleft attheendofsurgery.

Operativedifficultiesweredeterminedas difficultiesin/with:

- Denseomental&otherstructure adhesionstogallbladderandtheirdissection away,
- Dissectionof hepato-cystic triangle withidentification&isolationofbothcystic duct&artery,
- Clippingofwidemouthedcysticduct,
- Dissection ofthe gallbladder from liverbed,and
- Extractionofthegallbladder;if any.
- Intra-operative complicationswere determinedasoccurrenceof:
- Significanthemorrhage,
- Majorsourcebileleakage,
- Bileductinjury,and
- Nearbyorgansinjury;if any.

Conversion tolaparotomy or shift to cholecystostomywasrecorded.Thelength oftheoperations(inminutes,startingfrom umbilicalincision)wasrecorded.

Post-operatively:-All patients were permittedtoreceiveoralfluids and encouragedtobeambulated astolerated.The drainwasremovedwhentheoutputquantity fellbelow50mi.Peradayexceptcasesof biliaryleakage.Noneofthe selectedpatients wasspecificallymanaged inadaycasesetting orwithspecificanaesthesiaorpaincontrol.

Length ofpostoperativehospital stay wasrecordedindaysfromsurgery.

Post-operativecomplicationsbothearly and late: Up to **1** month of the surgery, were recorded. These were in the form of:- hemorrhage, hematoma, surgical site infection, port-site herniae, jaundice,bile leakage, bile duct injury and bile duct stricture;ifany.Theywereratedaccordingto theClavien-Deinogradingsystem.

Results:

Atthetimeofstudy,30instancesunderwent atrialoflaparoscopiccholecystectomy,more than72hoursfromthe onsetofsymptomsup to5weekslater. Ultra-sonicenergydevices (HarmonicScalpelandLigaSure)were the energizertoolsfor surgicaldissection.

Ourpatients(n:8,26.67%)weremales while(n:22,73.33%)werefemales.Their agesrangedfrom19yearsto59years,with ameanof39years. PatientsofASA 1were (n:23,67.67%);whileofASA2were(n:7, 23.33%).

Theindicationsofsurgerywere acute calculouscholecystitis(n:25,83.33%) and chronic calculouscholecystitis,diagnosed intra-operativelyashadarecentattack of acutecholecystitis,(n:5,16.67%).

Themeanintervalperiodfromtheonsetof symptomstillsurgerywas 3weeks.

Ofthe30laparoscopiccholecystectomies, 28 (93.33%)weresuccessfullycompleted ending withcompleteremovalofthe gallbladder. 2cases(6.67%)shiftedinto anotherprocedure. Onewasconvertedto laparotomy becauseoffailureofprecised identification andproperseparationofthe structuresformingthegallbladderphlegmon endingbysub-totalcholecystectomy. The other onewasproceededtocholecystostomy because ofheavilyscarredCalottriangle makingitsdissectionamatterofdangerboth laparoscopicallyandopen.

- Intra-operative difficulties: These were encountered in the successfully completelygroup(n:28,93.33%)wereinthe formof:
- Variabledensityofomental andother structuresadhesionswithdifficultseparation

(n:28,100%).

- Difficulty in grasping gallbladder fundus (becauseofwalloedemaordistended gallbladders)necessitatedtheirempting(n:7, 25%).
- DifficultdissectionatCalottriangle (n:13,46.43%).
- Cysticduct&arteryidentification, isolationandclipping(n:13,43.33%).
- Difficultdissectionofgallbladderoff itsliverbed(n:9,32.1%).
- Difficultextractionofthegallbladder necessitated surgicalsite extension (n: 3, 10.7%).

Thelengthofoperationwas(100-13OMin) withameanof115Min. Post-operative hospitalstaywas(1-2days)withameanof 1.5days.

Allabdominaldrainswereremoved 24 hoursaftertheoperationexceptonestayed for1week.Nointra-operativecomplications weremet.

Post-operativecomplications comprised (n:2cases,7.1%). Onewithbiliaryleakage (Clavien-Deinogradingsystem2b) treated onaconservativebasis, afterprompt exclusionofmajorductinjury,bykeeping theabdominaldrainfor1weekuntilthebile efflux spontaneouslyceased.Theothercase hadasuperficialsurgicalsiteinfectionatthe umbilical incision(Clavien-Deinograding system1)which wastheexitoftheinflamed gallbladder,alsoneededjustaconservative management.

Discussion:

Cholecystitisis the most prevalent surgicalconditionaffectingpopulations in industrialized countries.lAcute cholecystitishadinitiallybeenconsideredacontr aindicationtolaparoscopiccholecystectomybec auseof thehigherincidenceofcomplicationsthan innon-acutecholecystitis.9Theappropriate timingforearlylaparoscopiccholecystectomy inthetreatmentofacutecholecystitisremains controversial and the timing of surgery hasvariedinstudies.IOManystudiestried differentoperativetimingfromtheonsetof theacuteattack.Resultsshowedthat,delay of laparoscopic cholecystectomy beyond 72hoursfromtheonsetoftheacuteattack neitherincreases operativedifficultynor prolongrecovery withnoclinicalrelevant effectonconversionrates,operativetimes, morbidity,andpostoperativehospitalstay.It might bemorecosteffective.ll,I2,13

Inourstudy,laparoscopiccholecystectomy foracute gallbladderdiseasewasperformed morethan72hoursfromtheonset of symptomsupto5weekslater.

Toourknowledge,nostudydetermined intra-operativedifficultiesduringlaparoscopiccholec ystectomy inits acute pattern.We assume these in the settings of:-variable density of omentaland other structures adhesions,difficultyingraspinggallbladder fundus,difficultdissectionatCalottriangle, cysticduct&artery:Identification-isolation-clipping,difficultdissection of gallbladder off itsliverbedanddifficultextractionofthe gallbladder.Alldifficultiesinthecompleted groupwerebeenovercomewithnoimpact uponanyintra-operativemorbidity.

Inourstudynosignificantintra-operative complicationswere metspeciallybileduct injurycompared tootherstudyBileduct injurywas0.6%.14

Conversion toanother procedure was 6.67%. Compared toother studies which rangesfrom5.6to32%.15

Themeanintervalperiodfromtheonset ofsymptomstillsurgerywas3weeks.This was notfoundtohaveanysignificantbearing oncompletion/conversion oftheprocedure. AndwasparalleltoWangetal.Whoshowed thatnoimpactforthetimingoflaparoscopic cholecystectomyonconversionrate.I6

Electro-cauteryremainsthemainenergy form used during laparoscopic dissection, however because of its documented risks,altemativeforms of energy that can be used in laparoscopic dissection and even coagulating and sealing vesselsand ductsbeganveryearlyduringtheevolution of laparoscopic cholecystectomy itself. Ultrasonic energydissection was reported using different devices and terminology [Harmonic scalpel, ultrasonic shears, ultrasonically activated coagulating shears (UACS),UltracisionHarmonicShears(UHS),

CavitronUltrasonic Surgical Aspirator (CUSA)andLiga-Sure].I7

Thelengthofoperationsrangedbetween 100-130 Min.Withameanofl15Min. Comparedtootherstudywhichwaswitha mean50Min.I&

Thelength ofpost-operativestayranged between1-2dayswithameanofl.5days comparedtootherstudywhichwaswitha mean2.7days.I&

InourstudyweusedHarmonicscalpel andLiga-surewithahighthresholdofsafety &feasibilitywithanexcellentoutcomeinour patients.

Conclusion:

Laparoscopic cholecystectomyforacute gallbladderdisease,beyondtheconventional codedtimeof72hoursfrom theonsetof symptoms,usingultra-sonicenergydevices forsurgicaldissection;bearsahighthreshold ofsafety&feasibilitywithanexcellent outcome.

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