AORN Guideline for Electrosurgical Safety
Evidence Table

REFERENCE #	CITATION	EVIDENCE TYPE	SAMPLE SIZE/ POPULATION	INTERVENTION(S)	CONTROL/ COMPARISON	OUTCOME MEASURE(S)	CONCLUSION(S)	CONSENSUS SCORE
1	Jones DB, Brunt LM, Feldman LS, Mikami DJ, Robinson TN, Jones SB. Safe energy use in the operating room. Curr Probl Surg. 2015;52(11):447-468.	Literature Review	n/a	n/a	n/a	n/a	Provides a review of the different types of injuries caused by electrosurgery	VA
2	Suchanek S, Grega T, Zavoral M. The role of equipment in endoscopic complications. Best Pract Res Clin Gastroenterol. 2016;30(5):667-678.	Literature Review	n/a	n/a	n/a	n/a	Provides information about how electrosurgery works and interventions to prevent burns	VB
3	Law KS, Abbott JA, Lyons SD. Energy sources for gynecologic laparoscopic surgery: a review of the literature. Obstet Gynecol Surv. 2014;69(12):763-776.	Literature Review	n/a	n/a	n/a	n/a	Overview of the biophysics of energy sources, tissue effects, and the complications that may arise.	VA
4	Sankaranarayanan G, Resapu RR, Jones DB, Schwaitzberg S, De S. Common uses and cited complications of energy in surgery. Surg Endosc. 2013;27(9):3056-3072.	Literature Review	n/a	n/a	n/a	n/a	Describes precautions to take with argon beam coagulation.	VA
5	Hannah J. Probable postpolypectomy thermal burn: a case study. Gastroenterol Nurs. 2018;41(3):244-247.	Case Report	n/a	n/a	n/a	n/a	Describes a case of a patient developing thermal burn syndrome after a colonoscopy.	VC
6	Humes DJ, Ahmed I, Lobo DN. The pedicle effect and direct coupling: delayed thermal injuries to the bile duct after laparoscopic cholecystectomy. Arch Surg. 2010;145(1):96-98.	Case Report	n/a	n/a	n/a	n/a	Case report of injuries from pedicle effect and direct coupling.	VC
7	Sapienza P, Venturini L, Cigna E, Sterpetti AV, Biacchi D, di Marzo L. Deep gluteal grounding pad burn after abdominal aortic aneurysm repair. Ann Ital Chir. 2015;86(ePub).	Case Report	n/a	n/a	n/a	n/a	Deep tissue burns can occur beneath the dispersive electrode.	VB
8	Cormier B, Nezhat F, Sternchos J, Sonoda Y, Leitao MM Jr. Electrocautery-associated vascular injury during robotic-assisted surgery. Obstet Gynecol. 2012;120(2 Pt 2):491-493.	Case Report	n/a	n/a	n/a	n/a	Case report of 3 woman injured by capacitive coupling.	VB
9	Cassaro S. Delayed manifestations of laparoscopic bowel injury. Am Surg. 2015;81(5):478-482.	Literature Review	n/a	n/a	n/a	n/a	Review of literature on bowel injuries during laparoscopic procedures.	VA
10	Saaiq M, Zaib S, Ahmad S. Electrocautery burns: experience with three cases and review of literature. Ann Burns Fire Disasters. 2012;25(4):203-206.	Case Report	n/a	n/a	n/a	n/a	Case report of a dispersive electrode burn.	VB

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11	Huffman SD, Huffman NP, Lewandowski RJ, Brown DB. Radiofrequency ablation complicated by skin burn. Semin Intervent Radiol. 2011;28(2):179-182.	Case Report	n/a	n/a	n/a	n/a	Case study reporting on a dispersive electrode burn.	VC
12	Bansal A, Bhama JK, Varga JM, Toyoda Y. Airway fire during double-lung transplantation. Interact Cardiovasc Thorac Surg. 2013;17(6):1059-1060.	Case Report	n/a	n/a	n/a	n/a	Case report of a surgical fire with recommendations to decrease the potential for a fire.	VC
13	Hudson DW, Guidry OF, Abernathy JH 3rd, Ehrenwerth J. Case 4–2012. Intrathoracic fire during coronary artery bypass graft surgery. J Cardiothorac Vasc Anesth. 2012;26(3):520-521.	Case Report	n/a	n/a	n/a	n/a	Case report and commentary on a surgical fire.	VC
14	Herman MA, Laudanski K, Berger J. Surgical fire during organ procurement. Internet Journal of Anesthesiology. 2009;19(1).	Case Report	n/a	n/a	n/a	n/a	Case report of a fire during organ procurement	VC
15	Kim MS, Lee JH, Lee DH, Lee YU, Jung TE. Electrocautery-ignited surgical field fire caused by a high oxygen level during tracheostomy. Korean J Thorac Cardiovasc Surg. 2014;47(5):491-493.	Case Report	n/a	n/a	n/a	n/a	Case report of a fire during a tracheostomy	VC
16	Overbey DM, Townsend NT, Chapman BC, et al. Surgical energy-based device injuries and fatalities reported to the Food and Drug Administration. J Am Coll Surg. 2015;221(1):197-205.	Expert Opinion	n/a	n/a	n/a	n/a	The risk of injury from surgical energy devices is significant and warrants further research and education	VA
17	Mehta SP, Bhananker SM, Posner KL, Domino KB. Operating room fires: a closed claims analysis. Anesthesiology. 2013;118(5):1133-1139.	Case Report	n/a	n/a	n/a	n/a	Closed case analysis identifying the ignition sources for OR fires.	VB
18	Chung SH, Lee HH, Kim TH, Kim JS. A patient who was burned in the operative field: a case report. Ulus Travma Acil Cerrahi Derg. 2012;18(3):274-276.	Case Report	n/a	n/a	n/a	n/a	Report of a fire after use of alcohol to clean the sit	VC
19	Haith LR Jr, Santavasi W, Shapiro TK, et al. Burn center management of operating room fire injuries. J Burn Care Res. 2012;33(5):649-653.	Expert Opinion	n/a	n/a	n/a	n/a	Describes 5 cases of burns resulting from OR fires, and provides suggestions to decrease the potential of fires.	VC
20	Alkatout I, Schollmeyer T, Hawaldar NA, Sharma N, Mettler L. Principles and safety measures of electrosurgery in laparoscopy. JSLS. 2012;16(1):130-139.	Literature Review	n/a	n/a	n/a	n/a	Summary of precautions to take when using electrosurgery	VC

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21	Moskowitz M. Fire in the operating room during open heart surgery: a case report. AANA J. 2009;77(4):261-264.	Case Report	n/a	n/a	n/a	n/a	Case report of an OR fire.	VA
22	Chae SB, Kim WK, Yoo CJ, Park CW. Fires and burns occurring in an electrocautery after skin preparation with alcohol during a neurosurgery. J Korean Neurosurg Soc. 2014;55(4):230-233.	Case Report	n/a	n/a	n/a	n/a	Case report of a fire after use of an alcohol based product and not enough dry time.	VC
23	Lee JY, Park CB, Cho EJ, et al. Airway fire injury during rigid bronchoscopy in a patient with a silicon stent—a case report. Korean J Anesth. 2012;62(2):184-187.	Case Report	n/a	n/a	n/a	n/a	Case report of an airway fire.	VC
24	Liu Q., Sun XB. Indirect electrical injuries from capacitive coupling: a rarely mentioned electrosurgical complication in monopolar laparoscopy. Acta Obstet Gynecol Scand. 2013;92(2):238-241.	Case Report	n/a	n/a	n/a	n/a	Case report describing cases of complications resulting from laparoscopy monopolar electrosurgery use and recommendations to decrease incidence	VC
25	Messenger D, Carter F, Francis N. Electrosurgery and energized dissection. Surgery (Oxford). 2014;32(3):126-130.	Expert Opinion	n/a	n/a	n/a	n/a	Report on precautions to take when using ESU in the patient with and without an CIED	VB
26	Mumith A, Thuraisingham J, Gurunathan-Mani S. Ignition of free gas in the peritoneal cavity: an explosive complication. Case Rep Surg. 2013;2013:746430.	Case Report	n/a	n/a	n/a	n/a	Report of a fire upon entering a pneumoperitoneum using monopolar electrosurgery	VC
27	Abu-Rafea B, Vilos GA, Al-Obeed O, AlSheikh A, Vilos AG, Al-Mandeel H. Monopolar electrosurgery through single-port laparoscopy: a potential hidden hazard for bowel burns. J Minim Invasive Gynecol. 2011;18(6):734-740.	Nonexperimental	Sheep liver, pig bowel, dog bowel	n/a	n/a	Presence of capacitive or direct coupled burns.	Burns result from capacitive and direct coupling in simulated single port laparoscopic surgery performed using mono-polar electrosurgery	IIIB
28	Gunaruwan P, Barlow M. Diathermy-induced ventricular fibrillation with Riata high-voltage lead insulation failure. Europace. 2013;15(4):473.	Case Report	n/a	n/a	n/a	n/a	Case report of patient v-tach after use of a electrosurgery device due to ICD lead insulation failure.	VC

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29	Recommendations to reduce surgical fires and related patient injury: FDA Safety Communication. US Food and Drug Administration. https://www.fda.gov/medical-devices/safety-communications/recommendations-reduce-surgical-fires-and-related-patient-injury-fda-safety-communication. Updated July 18, 2018. Accessed March 30, 2020.	Expert Opinion	n/a	n/a	n/a	n/a	Recommendations to reduce fires in the OR and injuries from capacitive coupling and for the use of a holster.	VB
30	Healey JS, Merchant R, Simpson C, et al. Society Position Statement: Canadian Cardiovascular Society/Canadian Anesthesiologists' Society/Canadian Heart Rhythm Society joint position statement on the perioperative management of patients with implanted pacemakers, defibrillators, and neurostimulating devices. Can J Anesth. 2012;59(4):394-407.	Guideline	n/a	n/a	n/a	n/a	Provides guidance for care of a patient with an IED.	IVB
31	Crossley GH, Poole JE, Rozner MA, et al. The Heart Rhythm Society (HRS)/American Society of Anesthesiologists (ASA) Expert Consensus Statement on the perioperative management of patients with implantable defibrillators, pacemakers and arrhythmia monitors: facilities and patient management. Heart Rhythm. 2011;8(7):1114-1154.	Guideline	n/a	n/a	n/a	n/a	Guidelines describing treatment of a patient with CIEDs.	IVC
32	Lin Y, Melby DP, Krishnan B, Adabag S, Tholakanahalli V, Li JM. Frequency of pacemaker malfunction associated with monopolar electrosurgery during pulse generator replacement or upgrade surgery. J Interv Card Electrophysiol. 2017;49(2):205-209.	Nonexperimental	1398 patients with pacemakers and a review of the MAUDE database	n/a	n/a	Pacemaker malfunction	Various adverse events including loss of pacing , reversion to backup pacing , inappropriate low pacing rate , and ventricular fibrillation occurred because of electromagnetic interference.	IIIB
33	Goel AK, Korotkin S, Walsh D, Bess M, Frawley S. Monomorphic ventricular tachycardia caused by electrocautery during pacemaker generator change in a patient with normal left ventricular function. Pacing Clin Electrophysiol. 2009;32(7):957-958.	Case Report	n/a	n/a	n/a	n/a	Case report of a patient with an ICD who developed v-tach after contact was made between the lead and a monopolar electrosurgical device.	VC

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34	Cassagneau R, Hanninen M, Yee R. Electrocautery-induced ventricular fibrillation during routine implantable cardioverter-defibrillator generator replacement. Europace. 2014;16(3):319.	Case Report	n/a	n/a	n/a	n/a	Case report of a patient with an ICD developed v-fib after contact was made between the lead and a monopolar electrosurgical device.	VC
35	Russo V, Rago A, Di Meo F, et al. Ventricular fibrillation induced by coagulating mode bipolar electrocautery during pacemaker implantation in Myotonic Dystrophy type 1 patient. Acta Myol. 2014;33(3):149-151.	Case Report	n/a	n/a	n/a	n/a	List precautions to use to prevent interference in IEDs.	VB
36	Mohammed I, Ratib K, Creamer J. An unusual intracardiac electrogram showing cause for false electrical discharge from an ICD. BMJ Case Rep. 2013;2013.	Case Report	n/a	n/a	n/a	n/a	Case report of a patient having EMI sensed as v-fib.	VC
37	Castillo JG, Silvay G, Viles-González J. Perioperative assessment of patients with cardiac implantable electronic devices. Mt Sinai J Med. 2012;79(1):25-33.	Expert Opinion	n/a	n/a	n/a	n/a	Summary of care for a patient with a CIED	VB
38	King C. Endoscopic electrosurgery—an overview. Gastrointestinal Nursing. 2011;9(4):28-33.	Expert Opinion	n/a	n/a	n/a	n/a	Describes safety precaution to take when using an ESU including when using around an CIED.	VB
39	Fonseca AZ, Santin S, Gomes LG, Waisberg J, Ribeiro MA Jr. Complications of radiofrequency ablation of hepatic tumors: frequency and risk factors. World J Hepatol. 2014;6(3):107-113.	Literature Review	n/a	n/a	n/a	n/a	Recommendations for dispersive electrode placement.	VB
40	Munro MG. Complications of hysteroscopic and uterine resectoscopic surgery. Obstet Gynecol Clin North Am. 2010;37(3):399-425.	Expert Opinion	n/a	n/a	n/a	n/a	Provides recommendation for preventing electrosurgical injuries.	VB
41	Guideline for a safe environment of care. In: Guidelines for Perioperative Practice. Denver, CO: AORN, Inc; 2020:115-150.	Guideline	n/a	n/a	n/a	n/a	Provides guidance on prevention of surgical fires and electrical safety.	IVA
42	Guideline for surgical smoke safety. In: Guidelines for Perioperative Practice. Denver, CO: AORN, Inc; 2020:1007-1038.	Guideline	n/a	n/a	n/a	n/a	Provides guidance on evacuation of surgical smoke.	IVA
43	Guideline for minimally invasive surgery. In: Guidelines for Perioperative Practice. Denver, CO: AORN, Inc; 2020:482-514.	Guideline	n/a	n/a	n/a	n/a	Provides guidance on safe use of electrosurgery during laparoscopic procedures.	IVA

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44	Bisinotto FMB, Dezena RA, Martins LB, Galvão MC, Sobrinho JM, Calçado MS. Burns related to electrosurgery—report of two cases. Rev Bras Anestesiol. 2017;67(5):527-534.	Case Report	n/a	n/a	n/a	n/a	Case study with recommendations for electrosurgical safety.	VC
45	Townsend NT, Jones EL, Paniccia A, Vandervelde J, McHenry JR, Robinson TN. Antenna coupling explains unintended thermal injury caused by common operating room monitoring devices. Surg Laparosc Endosc Percutan Tech. 2015;25(2):111-113.	Quasi-experimental	Porcine model	Nonelectrically active neuromonitoring and cardiac-monitoring leads placed in proximity to the monopolar pencil and its cord. ESU set at 15 & 30 watts.	Nonelectrically active neuromonitoring and cardiac-monitoring leads were placed away from the monopolar pencil and its cord.	Tissue temperature	To decrease the amount of antenna coupling decrease the power, separate the wires and utilize low voltage devices.	IIB
46	Demirçin S, Aslan F, Karagöz YM, Atıgan M. Medicolegal aspects of surgical diathermy burns: a case report and review of the literature. Rom J Leg Med. 2013;21(3):173-176.	Case Report	n/a	n/a	n/a	n/a	Case report which recommends the proper placement of the grounding pad and other electrosurgery precautions.	VB
47	Makedonov I, Lee J. An evaluation of potential for alternate return site burns due to capacitive coupling between active electrode and ground while using electrosurgery units. J Clin Eng. 2011;36(1):29-31.	Nonexperimental	Computer generated model to determine the potential for alternate site burns from and ESU.	n/a	n/a	Amount of electrical current output.	The potential for an alternate site burn is very low because of current technology and a burn will only occur if specific conditions are present.	IIIC
48	O'Riley M. Electrosurgery in perioperative practice. J Periop Pract. 2010;20(9):329-333.	Expert Opinion	n/a	n/a	n/a	n/a	Provides recommendations for placing the dispersive electrode, and inspection of the system.	VC
49	Nelson G, Morris ML. Electrosurgery in the gastrointestinal suite: knowledge is power. Gastroenterol Nurs. 2015;38(6):430-439.	Expert Opinion	n/a	n/a	n/a	n/a	Summary of best practices for application of grounding pad and use of the ESU in a gastro-endoscopic setting.	VA
50	Vilos GA, Rajakumar C. Electrosurgical generators and monopolar and bipolar electrosurgery. J Minimally Invasive Gynecol. 2013;20(3):279-287.	Expert Opinion	n/a	n/a	n/a	n/a	Report on effects of electrosurgery including recommendations on handling of body piercings.	VA
51	Rey JF, Beilenhoff U, Neumann CS, Dumonceau JM; European Society of Gastrointestinal Endoscopy (ESGE). European Society of Gastrointestinal Endoscopy (ESGE) guideline: the use of electrosurgical units. Endoscopy. 2010;42(9):764-772.	Guideline	n/a	n/a	n/a	n/a	Clinical guideline on managing patients with and IED	IVC

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52	Gould J. Overview of electrosurgery. UptoDate. https://www.uptodate.com/contents/overview-of-electrosurgery. Last updated: January 7, 2019. Accessed March 30, 2020.	Expert Opinion	n/a	n/a	n/a	n/a	Recommends use of AEM, REM and alternate technologies when patient has an IED.	VB
53	Nguyen DT, Barham W, Zheng L, Dinegar S, Tzou WS, Sauer WH. Effect of radiofrequency energy delivery in proximity to metallic medical device components. Heart Rhythm. 2015;12(10):2162-2169.	Nonexperimental	Laboratory simulation	n/a	n/a	Thermal changes near the site of the implanted metal objects.	The grounding pad should be placed to avoid metal between it and the RF ablation active electrode	IIIB
54	Sheldon RR, Loughren MJ, Marenco CW, et al. Microdermal implants show no effect on surrounding tissue during surgery with electrocautery. J Surg Res. 2019;241:72-77.	Quasi-experimental	4 swine with 3 implants in each.	Skin temperature at site between active and passive electrode sites	Skin temperature at site of dermal implant between active and passive electrode sites	Skin temperature at stainless steel dermal implant sites between the active and passive electrode	Stainless steel dermal implants	IIB
55	Roy S, Smith LP. Device-related risk of fire in oropharyngeal surgery: a mechanical model. Am J Otolaryngol. 2010;31(5):356-359.	Nonexperimental	Laboratory setting.	n/a	n/a	Time to ignition	Use of a bipolar device decreases the risk of fire during open cavity surgery	IIIC
56	Matt BH, Cottee LA. Reducing risk of fire in the operating room using coblation technology. Otolaryngol Head Neck Surg. 2010;143(3):454-455.	Nonexperimental	Laboratory study	n/a	n/a	Presence of fire	Coblation technology produces lower temperatures therefore reduces risk of fire.	IIIC
57	González CEM, Fernández VO. Case report: airway burn. Colombian Journal of Anesthesiology. 2013;41(3):226-228.	Case Report	n/a	n/a	n/a	n/a	Provides guidance regarding precautions to take to prevent an airway fire when using electrosurgery.	VB
58	Roy S, Smith LP. Preventing and managing operating room fires in otolaryngology-head and neck surgery. Otolaryngol Clin North Am. 2019;52(1):163-171.	Expert Opinion	n/a	n/a	n/a	n/a	Provides recommendations on various fire prevention interventions when using electrosurgery including using alternative technology when opening the trachea	VA
59	AST Standards of Practice for Use of Electrosurgery. Littleton, CO: Association of Surgical Technologists; 2012.	Guideline	n/a	n/a	n/a	n/a	Provides guidance on the use of electrosurgery	IVC
60	Dennis E. Decreasing airway fires. OR Nurse 2012. 2012;6(2):37-40.	Expert Opinion	n/a	n/a	n/a	n/a	Provides guidance on OR fire prevention	VB
61	Partanen E, Koljonen V, Salonen A, Bäck LJ, Vuola J. A patient with intraoral fire during tonsillectomy. J Craniofac Surg. 2014;25(5):1822-1824.	Case Report	n/a	n/a	n/a	n/a	Moisten sponges in the vicinity of the ignition device.	VA

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62	Smędra A, Meissner E, Barzdo M, et al. Iatrogenic burns of the neckline in a patient with tetraparesis during tracheotomy. J Forensic Sci. 2017;62(1):250-253.	Case Report	n/a	n/a	n/a	n/a	Alcohol based skin preparation agents can ignite when an ESU is used.	VC
63	Smędra A, Meissner E, Barzdo M, et al. Iatrogenic burns of the neckline in a patient with tetraparesis during tracheotomy. J Forensic Sci. 2017;62(1):250-253.	Case Report	n/a	n/a	n/a	n/a	Case report of a fire and a list of best practices obtained from a review of the literature	VA
64	Seifert PC, Peterson E, Graham K. Crisis management of fire in the OR. AORN J. 2015;101(2):250-263.	Expert Opinion	n/a	n/a	n/a	n/a	Describes actions to take to prevent and fight an OR fire.	VA
65	Khatiwada S, Bhattarai B, Acharya R, Chettri ST, Dhital D, Rahman TR. Surgical site fire: a case of evil spirit or lapsed communication? Nepal Med Coll J. 2011;13(2):140-141.	Case Report	n/a	n/a	n/a	n/a	Describes a fire resulting from ignition of an alcohol soaked sponge by an electrosurgical active electrode.	VA
66	Apfelbaum JL, Caplan RA, Barker SJ, et al. Practice advisory for the prevention and management of operating room fires: an updated report by the American Society of Anesthesiologists Task Force on Operating Room Fires. Anesthesiology. 2013;118(2):271-290.	Guideline	n/a	n/a	n/a	n/a	Evidence based guidelines for fire prevention and management from the ASA.	IVA
67	Axelrod EH, Kusnetz AB, Rosenberg MK. Operating room fires initiated by hot wire cautery. Anesthesiology. 1993;79(5):1123-1126.	Nonexperimental	Laboratory setting. Various materials found in an OR.	n/a	n/a	Flammability	Moist sponges should be used near the ignition site when using electrocautery	IIIB
68	Fire caused by improper disposal of a battery-powered electrocautery pen. Health Devices. 2013;42(10):346.	Case Report	n/a	n/a	n/a	n/a	Case report of a fire caused by an electrocautery device.	VC
69	Potty AG, Khan W, Tailor HD. Diathermy in perioperative practice. J Perioper Pract. 2010;20(11):402-405.	Literature Review	n/a	n/a	n/a	n/a	Description of principles of electrosurgery & precautions to take to prevent injury.	VB
70	Medical Device Reporting (MDR): How to report medical device problems. US Food and Drug Administration. https://www.fda.gov/medical-devices/medical-device-safety/medical-device-reporting-mdr-how-report-medical-device-problems. Updated July 8, 2019. Accessed March 30, 2020.	Regulatory	n/a	n/a	n/a	n/a	Provides recommendations regarding mandatory reporting of equipment failures to the FDA.	n/a

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71	Robinson TN, Pavlovsky KR, Looney H, Stiegmann GV, McGreevy FT. Surgeon-controlled factors that reduce monopolar electrosurgery capacitive coupling during laparoscopy. Surg Laparosc Endosc Percutan Tech. 2010;20(5):317-320.	Quasi-experimental	Experimental laboratory setting	Power setting of 25,50,75,100 Watts	n/a	n/a	Lower power settings should be used to decrease the amount of energy lost through capacitive coupling.	IIA
72	Robinson TN, Barnes KS, Govekar HR, Stiegmann GV, Dunn CL, McGreevy FT. Antenna coupling—a novel mechanism of radiofrequency electrosurgery complication: practical implications. Ann Surg. 2012;256(2):213-218.	Quasi-experimental	Porcine tissue	Cords placed apart	Cords in close proximity	Thermal injury at the camera trocar incision	The cords on the sterile field should be separated to decrease the amount of antenna coupling to the camera	IIB
73	Mitchell ME, Kidd D, Lotto ML, et al. Determination of factors influencing tissue effect of thermal chondroplasty: an ex vivo investigation. Arthroscopy. 2006;22(4):351-355.	Quasi-experimental	Adult bovine patellae	Output power of 50	Output power of 110	Thickness of tissue effect	Lower power settings should be used.	IIB
74	Itoi T, Isayama H, Sofuni A, et al. Evaluation of effects of a novel endoscopically applied radiofrequency ablation biliary catheter using an ex-vivo pig liver. J Hepatobiliary Pancreat Sci. 2012;19(5):543-547.	Quasi-experimental	Pig livers	5, 10, 15, and 20 W	60,90,120 seconds	Effects of RF ablation	The time of exposure and the power settings be based up the size of the masses using the present results as a base for the decision.	IIB
75	Goulet CJ, Disario JA, Emerson L, Hilden K, Holubkov R, Fang JC. In vivo evaluation of argon plasma coagulation in a porcine model. Gastrointest Endosc. 2007;65(3):457-462.	Quasi-experimental	Laboratory using swine intestine	Argon plasma coagulation via colonoscopy at 10W, 20W, 40W, and 60W.	5, 10 or 15 seconds	Thermal damages	The lowest energy settings and the shortest duration of energy application have the lowest risk of deep tissue injury.	IIB
76	Huang Y, Zhang Y, Ding X, Liu S, Sun T. Working conditions of bipolar radiofrequency on human articular cartilage repair following thermal injury during arthroscopy. Chin Med J (Engl).	Quasi-experimental	Osteochondral explants	Bipolar power levels of 2, 4 and 6;	2, 5 and 10 seconds	Percentage and depth of cell damage	A lower power level creates less cellular damage.	IIB
77	Sutton PA, Awad S, Perkins AC, Lobo DN. Comparison of lateral thermal spread using monopolar and bipolar diathermy, the Harmonic Scalpel and the Ligasure. Br J Surg. 2010;97(3):428-433.	Quasi-experimental	Porcine muscle	Monopolar at 20, 30 and 40 Watts	5, 10 or 15 seconds	Thermal spread	There is increased thermal spread with increased power settings	IIB

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78	Martinek M, Bencsik G, Aichinger J, et al. Esophageal damage during radiofrequency ablation of atrial fibrillation: impact of energy settings, lesion sets, and esophageal visualization. J Cardiovasc Electrophysiol. 2009;20(7):726-733.	Quasi-experimental	175 patients having radiofrequency ablation	25 watts power short duration, 15 watts power long duration	25 watts power, long duration	Presence of esophageal ulcerations	During radiofrequency ablation lower energy levels are safer than higher levels	IIB
79	Brzeziński J, Kałużna-Markowska K, Naze M, Stróżyk G, Dedecjus M. Comparison of lateral thermal spread using monopolar and bipolar diathermy, and the bipolar vessel sealing system ThermoStaplerTM during thyroidectomy. Pol Przegl Chir. 2011;83(7):355-360.	Nonexperimental	75 patient having elective total thyroidectomies	n/a	n/a	Amount of thermal injury	Lower power settings create less thermal injury.	IIIB
80	Jones EL, Robinson TN, McHenry JR, et al. Radiofrequency energy antenna coupling to common laparoscopic instruments: practical implications. Surg Endosc. 2012;26(11):3053-3057.	Nonexperimental	Bovine liver	n/a	n/a	Temperature at end of scope and grasper.	The electrosurgical cords should be as far as possible from the light cords and the lowest power setting should be used.	IIIB
81	Munro MG. Mechanisms of thermal injury to the lower genital tract with radiofrequency resectoscopic surgery. J Minim Invasive Gynecol. 2006;13(1):36-42. Erratum in: J Minim Invasive Gynecol. 2007;14(2):268.	Nonexperimental	Simulated female lower genital tract	n/a	n/a	Presence and degree of burns	Higher ESU output power results in more injuries than lower output. Damage to the insulation on the active electrode results in injury to the tissue via coupling	IIIB
82	Lowe D, Cromwell DA, Lewsey JD, et al. Diathermy power settings as a risk factor for hemorrhage after tonsillectomy. Otolaryngol Head Neck Surg. 2009;140(1):23-28.	Nonexperimental	8,465 patients having tonsillectomy	n/a	n/a	Percentage of hemorrhages	There is a lower rate of hemorrhage when a lower power setting is used in patients having a cold steel tonsil dissection using bipolar diathermy for hemostasis.	IIIA
83	Hefermehl LJ, Largo RA, Hermanns T, Poyet C, Sulser T, Eberli D. Lateral temperature spread of monopolar, bipolar and ultrasonic instruments for robot-assisted laparoscopic surgery. BJU Int. 2014;114(2):245-252.	Nonexperimental	laboratory using fresh bovine muscle fascia	n/a	n/a	Amount of heat spread at 30,60, and 90 watts	The heat spread increased with increasing power, therefore procedures should be started with the lowest power setting	IIIB

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84	Robinson TN, Varosy PD, Guillaume G, et al. Effect of radiofrequency energy emitted from monopolar "Bovie" instruments on cardiac implantable electronic devices. J Am Coll Surg. 2014;219(3):399-406.	Nonexperimental	Pig hearts	n/a	n/a	Amount of EMI received by the CIED	The lowest power should be used, the active electrode cord should be placed at the greatest distance possible from the CIED generator and the CIED generator should not be in pathway of the current from the active electrode to the dispersive electrode.	IIIB
85	Govekar HR, Robinson TN, Varosy PD, et al. Effect of monopolar radiofrequency energy on pacemaker function. Surg Endosc. 2012;26(10):2784-2788.	Nonexperimental	Pig heart	n/a	n/a	Missed pacemaker beats	The lowest power setting should be used and the dispersive electrode should be placed so the current vector does not travel through the pacemaker	IIIC
86	CSA Z387-2019. Safe Use of Electrosurgical Medical Devices and Systems in Health Care. Toronto, ON: CSA Group; 2019.	Guideline	n/a	n/a	n/a	n/a	Provides guidance for use of an ESU	IVC
87	Metzner A, Wissner E, Schoonderwoerd B, et al. The influence of varying energy settings on efficacy and safety of endoscopic pulmonary vein isolation. Heart Rhythm. 2012;9(9):1380-1385.	Nonexperimental	10 patients having pulmonary vein isolation in each group.	n/a	n/a	Pulmonary vein isolation and possible side effects at 5.5 and 7.0 W, 7.0 and 8.5 W and 8.5 and 10.0 W	Higher energy levels are safe and are more effecient	IIIB
88	Sabzi F, Niazi M, Ahmadi A. Rare case-series of electrocautery burn following off-pump coronary artery bypass grafting. J Inj Violence Res. 2014;6(1):44-49.	Case Report	n/a	n/a	n/a	n/a	Case report of alternate site burns.	VB
89	Sanders SM, Krowka S, Giacobbe A, Bisson LJ. Third-degree burn from a grounding pad during arthroscopy. Arthroscopy. 2009;25(10):1193-1197.	Case Report	n/a	n/a	n/a	n/a	Case study reporting on a dispersive electrode burn	VB
90	Gil Franco F, Bailard N. Peripheral nerve stimulator response triggered by proximity to electrosurgical unit. Anesth Analg. 2012;114(5):1142-1143.	Case Report	n/a	n/a	n/a	n/a	Case report of a nerve stimulator misfiring every time the ESU on which it was setting was activated	VC
91	Guglielmi CL, Flowers J, Dagi TF, et al. Empowering providers to eliminate surgical fires. AORN J. 2014;100(4):412-428.	Expert Opinion	n/a	n/a	n/a	n/a	Provides guidance on OR fire prevention	VB

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92	State Operations Manual Appendix L: Guidance for Surveyors: Ambulatory Surgical Centers. Rev. 200, 02-21-20. Centers for Medicare & Medicaid Services. https://www.cms.gov/media/423701. Accessed March 31, 2020.	Regulatory	n/a	n/a	n/a	n/a	Regulations regarding maintenance of equipment	n/a
93	State Operations Manual Appendix A: Survey Protocol, Regulations and Interpretive Guidelines for Hospitals. Rev. 200, 02-21-20. Centers for Medicare & Medicaid Services. https://www.cms.gov/media/423601. Accessed March 31, 2020.	Regulatory	n/a	n/a	n/a	n/a	Regulations regarding maintenance of equipment	n/a
94	Guideline for patient information management. In: Guidelines for Perioperative Practice. Denver, CO: AORN, Inc; 2020:357-386.	Guideline	n/a	n/a	n/a	n/a	Provides guidance on perioperative documentation.	IVA
95	Hachach-Haram N, Saour S, Alamouti R, Constantinides J, Mohanna PN. Labelling of diathermy consoles when multiple systems are used: should this be part of the WHO checklist? BMJ Qual Saf. 2013;22(9):775-776.	Organizational Experience	n/a	n/a	n/a	n/a	Recommends labeling of ESU and corresponding accessories when more than one ESU is used.	VB
96	Townsend NT, Nadlonek NA, Jones EL, et al. Unintended stray energy from monopolar instruments: beware the dispersive electrode cord. Surg Endosc. 2016;30(4):1333-1336.	Nonexperimental	Laboratory simulation	n/a	n/a	Temperature increase at the end of the telescope	Passive electrode and camera cords should be separated during laparoscopic procedures.	IIIC
97	Townsend NT, Jones EL, Overbey D, Dunne B, McHenry J, Robinson TN. Single-incision laparoscopic surgery increases the risk of unintentional thermal injury from the monopolar "Bovie" instrument in comparison with traditional laparoscopy. Surg Endosc. 2017;31(8):3146-3151.	Nonexperimental	Laboratory simulation	n/a	n/a	Temperature increase at the end of the telescope and the Maryland	Active electrode and camera cords should be separated during 4 port laparoscopic procedures but no benefit was seen during single port procedures.	IIIC
98	Robinson TN, Jones EL, Dunn CL, et al. Separating the laparoscopic camera cord from the monopolar "Bovie" cord reduces unintended thermal injury from antenna coupling: a randomized controlled trial. Ann Surg. 2015;261(6):1056-1060.	RCT	84 patients undergoing laparoscopic cholecystectomy	Separated active electrode/camera cords.	Active electrode/camera cords placed parallel and close together	Thermal injury at the camera trocar incision	The laparoscopic camera cord and the active electrode cord should be separated to decrease the amount of antenna coupling at the camera trocar incision.	IA

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99	Brill AI. Electrosurgery: principles and practice to reduce risk and maximize efficacy. Obstet Gynecol Clin North Am. 2011;38(4):687-702.	Literature Review	n/a	n/a	n/a	n/a	The active electrode should be cleaned, electrode tips should be inspected prior to use, trocars may be a conductor, and use the lowest power setting.	VB
100	Shah AJ, Janes R, Holliday J, Thakur R. Radiofrequency transseptal catheter electrode fracture. Pacing Clin Electrophysiol. 2010;33(6):e57-e58.	Case Report	n/a	n/a	n/a	n/a	Case report of a broken RFA catheter.	VB
101	Hazard report. internal wire breakage in reusable electrosurgical active electrode cables may cause sparking and surgical fires. Health Devices. 2009;38(7):228-229.	Expert Opinion	n/a	n/a	n/a	n/a	Report on procedure to follow to prevent injury from cables breaking	VB
102	Guideline for cleaning and care of surgical instruments. In: Guidelines for Perioperative Practice. Denver, CO: AORN, Inc; 2020:387-426.	Guideline	n/a	n/a	n/a	n/a	Provides guidance for care and clearing of instruments.	IVA
103	Montero PN, Robinson TN, Weaver JS, Stiegmann GV. Insulation failure in laparoscopic instruments. Surg Endosc. 2010;24(2):462-465.	Nonexperimental	165 reusable laparoscopic insulated active electrodes and 61 disposable	n/a	n/a	Insulation failure	Insulation failure is frequently present and an inspection should be performed before and during use.	IIIB
104	Espada M, Munoz R, Noble BN, Magrina JF. Insulation failure in robotic and laparoscopic instrumentation: a prospective evaluation. Am J Obstet Gynecol. 2011;205(2):121.e1-121.e5.	Nonexperimental	744 Robotic and laparoscopic instruments	n/a	n/a	Insulation failure	There is a high incidence of insulation failure in robotic and laparoscopic instruments. Routine testing should be performed.	IIIB
105	Tixier F, Garçon M, Rochefort F, Corvaisier S. Insulation failure in electrosurgery instrumentation: a prospective evaluation. Surg Endosc. 2016;30(11):4995-5001.	Nonexperimental	489 instruments	n/a	n/a	Insulation failure	24.1 % of the instruments failed by visual inspection and 37.2% failed with the use of an active electrode insulation integrity tester. The failure in 50.4% of the laparoscopic instruments was median and the failure was distal in 40.4% of non-laparoscopic	IIIA
106	Alternate-site burns from improperly seated or damaged electrosurgical pencil active electrodes. Health Devices. 2012;41(10):334.	Expert Opinion	n/a	n/a	n/a	n/a	Properly seat the active electrode tip into the hand piece.	VC
107	Lowry TR, Workman JR. Avoiding oral burns during electrocautery tonsillectomy. Ear Nose Throat J. 2009;88(2):790-792.	Expert Opinion	n/a	n/a	n/a	n/a	Report on precautions to perform to reduce injuries while using ESU.	VC

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108	Baker JC, Ramadan HH. The effects of an antistick phospholipid solution on pediatric electrocautery adenoidectomy. Ear Nose Throat J. 2012;91(1):E20-E23.	RCT	61 Pediatric adenoidectomies	Application of phospholipid antistick solution	No antistick solution	Surgery time and number of hand backs	Application of antistick solution decreased surgical time and number of hand backs.	IA
109	Roy S, Buckingham H, Buckingham E. The effects of an antistick phospholipid solution on bipolar electrocautery efficacy in rhytidectomy. Am J Cosmet Surg. 2017;34(3):156-160.	RCT	50 patients having rhytidectomy	Application of phospholipid antistick solution	No antistick solution	Surgery time and number of times bipolar cautery tip was cleaned	Application of antistick solution decreased surgical time and number of hand backs.	IB
110	Sanders A, Andras L, Lehman A, Bridges N, Skaggs DL. Dermal discolorations and burns at neuromonitoring electrodes in pediatric spine surgery. Spine (Phila PA 1976). 2017;42(1):20-24.	Organizational Experience	201 patients having spinal surgery.	n/a	n/a	n/a	Place dispersive electrode away from bony prominences, but over well perfused areas, unbundle cords especially when near electrodes.	VA
111	Gallagher K, Dhinsa B, Miles J. Electrosurgery. Surgery. 2011;29(2):70-72.	Expert Opinion	n/a	n/a	n/a	n/a	Report on precautions to take to avoid burns during electrosurgery	VB
112	Ertuğrul İ, Karagöz T, Aykan HH. A rare complication of radiofrequency ablation: skin burn. Cardiol Young. 2015;25(7):1385-1386.	Case Report	n/a	n/a	n/a	n/a	Report of a burn under the dispersive electrode	VC
113	Dhillon PS, Gonna H, Li A, Wong T, Ward DE. Skin burns associated with radiofrequency catheter ablation of cardiac arrhythmias. Pacing Clin Electrophysiol. 2013;36(6):764-767.	Case Report	n/a	n/a	n/a	n/a	Case report on a dispersive electrode burn.	VC
114	Odell RC. Surgical complications specific to monopolar electrosurgical energy: engineering changes that have made electrosurgery safer. J Minim Invasive Gynecol. 2013;20(3):288-298.	Expert Opinion	n/a	n/a	n/a	n/a	Supports the use of CQM and AEM.	VB
115	Talati RK, Dein EJ, Huri G, McFarland EG. Cutaneous burn caused by radiofrequency ablation probe during shoulder arthroscopy. Am J Orthop (Belle Mead NJ). 2015;44(2):E58-E60.	Case Report	n/a	n/a	n/a	n/a	Avoid contact between an ablation device and other medal objects.	VA
116	Martin KE, Moore CM, Tucker R, Fuchshuber P, Robinson T. Quantifying inadvertent thermal bowel injury from the monopolar instrument. Surg Endosc. 2016;30(11):4776-4784.	Nonexperimental	Porcine tissue	n/a	n/a	Amount of energy passed by capacitive coupling and the number of burns from insulation breaks.	The use of an active electrode monitoring equipment decreased the number of burns and the amount of energy passed by capacitive coupling.	IIIB

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117	Guzman C, Forrester JA, Fuchshuber PR, Eakin JL. Estimating the incidence of stray energy burns during laparoscopic surgery based on two statewide databases and retrospective rates: an opportunity to improve patient safety. Surg Technol Int. 2019;34:30-34.	Nonexperimental	192,794 records of patients having laparoscopic abdominal procedures.	n/a	n/a	Presence of an accidental puncture or laceration.	694 patients had an accidental puncture or laceration. To decrease the rate there should be education provided and use of active electrode monitoring.	IIIA
118	Mendez-Probst CE, Vilos G, Fuller A, et al. Stray electrical currents in laparoscopic instruments used in da Vinci® robot-assisted surgery: an in vitro study. J Endourol. 2011;25(9):1513-1517.	Nonexperimental	37 robotic instruments	n/a	n/a	Amount of stray electrical currents	Active electrode monitoring should be employed on robotic instruments.	IIIB
119	Schulman PM, Rozner MA. Case report: use caution when applying magnets to pacemakers or defibrillators for surgery. Anesth Analg. 2013;117(2):422-427.	Case Report	n/a	n/a	n/a	n/a	Case report of cases having complications after use of ESU in a patient having an CIED	VA
120	Ubee SS, Kasi VS, Bello D, Manikandan R. Implications of pacemakers and implantable cardioverter defibrillators in urological practice. J Urol. 2011;186(4):1198-1205.	Literature Review	n/a	n/a	n/a	n/a	Summary of recommendations for care of the patient with an IED.	VA
121	Peter NM, Ribes P, Khooshabeh R. Cardiac pacemakers and electrocautery in ophthalmic surgery. Orbit. 2012;31(6):408-411.	Expert Opinion	n/a	n/a	n/a	n/a	Recommendations for caring for patient with an IED, having ophthalmic surgery.	VC
122	Stone ME, Salter B, Fischer A. Perioperative management of patients with cardiac implantable electronic devices. Br J Anaesth. 2011;107(Suppl 1):i16-i26.	Expert Opinion	n/a	n/a	n/a	n/a	Report on precautions to take when using ESU in the patient with an CIED	VA
123	Voutsalath MA, Bichakjian CK, Pelosi F, Blum D, Johnson TM, Farrehi PM. Electrosurgery and implantable electronic devices: review and implications for office-based procedures. Dermatol Surg. 2011;37(7):889-899.	Expert Opinion	n/a	n/a	n/a	n/a	Provides recommendations for the care of patients having an IED and electrosurgery is used.	VA
124	Howe N, Cherpelis B. Obtaining rapid and effective hemostasis: part II. electrosurgery in patients with implantable cardiac devices. J Am Acad Dermatol. 2013;69(5):677.e1-677.e9.	Literature Review	n/a	n/a	n/a	n/a	Recommendations on precautions to use when patient has a IED	VC

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125	Venkatraghavan L, Chinnapa V, Peng P, Brull R. Non-cardiac implantable electrical devices: brief review and implications for anesthesiologists. Can J Anaesth. 2009;56(4):320-326.	Literature Review	n/a	n/a	n/a	n/a	Recommendations for care of the patient with a non-cardiac IED.	VA
126	Navaratnam M, Dubin A. Pediatric pacemakers and ICDs: how to optimize perioperative care. Paediatr Anaesth. 2011;21(5):512-521.	Expert Opinion	n/a	n/a	n/a	n/a	Recommendations for handling a pediatric patient with an IED	VB
127	García Bracamonte B, Rodriguez J, Casado R, Vanaclocha F. Electrosurgery in patients with implantable electronic cardiac devices (pacemakers and defibrillators). Actas Dermosifiliogr. 2013;104(2):128-132.	Expert Opinion	n/a	n/a	n/a	n/a	Recommendations to take when caring for a patient with an implantable electronic device.	VB
128	Chia PL, Foo D. A practical approach to perioperative management of cardiac implantable electronic devices. Singapore Med J. 2015;56(10):538-541.	Expert Opinion	n/a	n/a	n/a	n/a	Recommends that a multidisciplinary team evaluate patients with IEDs.	VB
129	Stone ME, Apinis A. Current perioperative management of the patient with a cardiac rhythm management device. Semin Cardiothorac Vasc Anesth. 2009;13(1):31-43.	Expert Opinion	n/a	n/a	n/a	n/a	Recommendations for when using ESU in the patient with an CIED	VB
130	Pavlović S, Milasinović G, Zivković M. Approach to patients with implanted pacemaker and scheduled surgical or diagnostic procedure. Acta Chir Iugosl. 2011;58(2):25-29.	Expert Opinion	n/a	n/a	n/a	n/a	Recommendations for caring for patient with an IED.	VC
131	Tom J. Management of patients with cardiovascular implantable electronic devices in dental, oral, and maxillofacial surgery. Anesth Prog. 2016;63(2):95-104.	Literature Review	n/a	n/a	n/a	n/a	Recommendations for caring for patient with a pacemaker during dental and maxillofacial surgery	VB
132	Kumar A, Dhillon SS, Patel S, Grube M, Noheria A. Management of cardiac implantable electronic devices during interventional pulmonology procedures. J Thorac Dis. 2017;9(Suppl 10):S1059-S1068.	Expert Opinion	n/a	n/a	n/a	n/a	Provides recommendations for caring for the patient with an IED during interventional pulmonology procedures.	VA

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133	Practice advisory for the perioperative management of patients with cardiac implantable electronic devices: pacemakers and implantable cardioverter–defibrillators 2020: an updated report by the American Society of Anesthesiologists Task Force on Perioperative Management of Patients with Cardiac Implantable Electronic Devices. Anesthesiology. 2020;132(2):225-252.	Guideline	n/a	n/a	n/a	n/a	Provides guidance for care of a patient with an IED.	IVA
134	Sticherling C, Menafoglio A, Burri H, et al. Recommendations for the peri-operative management of patients with cardiac implantable electronic devices. Kardiovaskulare Medizin. 2016;19(1):13-18.	Position Statement	n/a	n/a	n/a	n/a	Recommendations for care of the patient with a CIED	IVC
135	Rozner MA. Perioperative care of the patient with a cardiac pacemaker or ICD. Revista Mexicana de Anestesiologia. 2009;32(Suppl 1):S190-S197.	Expert Opinion	n/a	n/a	n/a	n/a	Recommendations for care when using an ESU in the patient with an CIED	VB
136	Ramos JA, Brull SJ. Perioperative management of multiple noncardiac implantable electronic devices. A A Case Rep. 2015;5(11):189-191.	Case Report	n/a	n/a	n/a	n/a	Recommendations for caring of a patient with a CIED	VA
137	Harned ME, Gish B, Zuelzer A, Grider JS. Anesthetic considerations and perioperative management of spinal cord stimulators: literature review and initial recommendations. Pain Physician. 2017;20(4):319-329.	Literature Review	n/a	n/a	n/a	n/a	Recommendations for caring of a patient with a spinal cord stimulator	VA
138	Hammwöhner M, Stachowitz J, Willich T, Goette A. Induction of ventricular tachycardia during radiofrequency ablation via pulmonary vein ablation catheter in a patient with an implanted pacemaker. Europace. 2012;14(2):298-299.	Case Report	n/a	n/a	n/a	n/a	Case report of a patient with an ICD who developed v-tach resulting from antenna coupling between the lead and a monopolar electrosurgical device. Author recommends using bipolar energy.	VC
139	Wong TS, Abu Bakar J, Chee KH, et al. Posterior spinal fusion in a scoliotic patient with congenital heart block treated with pacemaker: an intraoperative technical difficulty. Spine. 2019;44(4):E252-E257.	Case Report	n/a	n/a	n/a	n/a	Recommendations to take for caring for patient with a pacemaker having spinal surgery	VC

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140	Beinart R, Nazarian S. Effects of external electrical and magnetic fields on pacemakers and defibrillators: from engineering principles to clinical practice. Circulation. 2013;128(25):2799-2809.	Case Report	n/a	n/a	n/a	n/a	Recommendations for caring for a patient with an IED.	VA
141	Friedman H, Higgins JV, Ryan JD, Konecny T, Asirvatham SJ, Cha YM. Predictors of intraoperative electrosurgery-induced implantable cardioverter defibrillator (ICD) detection. J Interv Card Electrophysiol. 2017;48(1):21-26.	Nonexperimental	103 patient records	n/a	n/a	Presence of electromechanical interference in a cardioverter-defibrillator.	EMI does not occur when bipolar technology is used or when the surgical site and the dispersive site is below the hip joint.	IIIB
142	Jeyakumar A, Wilson M, Sorrel JE, et al. Monopolar cautery and adverse effects on cochlear implants. JAMA Otolaryngol Head Neck Surg. 2013;139(7):694-697.	Nonexperimental	Laboratory study	n/a	n/a	Increase in temperature or damage to cochlear implant	No damage or temperature increase occurred but before changing the current practice as stated in the intervention further study is required	IIIB
143	Misiri J, Kusumoto F, Goldschlager N. Electromagnetic interference and implanted cardiac devices: the medical environment (part II). Clin Cardiol. 2012;35(6):321-328.	Expert Opinion	n/a	n/a	n/a	n/a	Report on precautions to take on a patient with a CIED.	VA
144	Santini L, Forleo GB, Santini M. Implantable devices in the electromagnetic environment. J Arrhythm. 2013;29(6):325-333.	Expert Opinion	n/a	n/a	n/a	n/a	Recommendations to take when using ESU in the patient with an CIED	VB
145	Paniccia A, Rozner M, Jones EL, et al. Electromagnetic interference caused by common surgical energy-based devices on an implanted cardiac defibrillator. Am J Surg. 2014;208(6):932-936.	Nonexperimental	laboratory using an EMI implanted in a pig heart	n/a	n/a	Amount of EMI present with use of multiple energy devices	Bipolar and ultrasonic devices cause lower levels of EMI on implanted cardiac defibrillators compared to monopolar devices.	IIIB
146	Frampton SJ, Ismail-Koch H, Mitchell TE. How safe is diathermy in patients with cochlear implants? Ann R Coll Surg Engl. 2012;94(8):585-587.	Qualitative	35 ENT surgeons	n/a	n/a	Amount of knowledge on the interaction of cochlear implant and electrosurgery	Additional education is needed on proper use of devices for endometrial ablation.	IIIB
147	Behan J, Higgins S, Wysong A. Safety of cochlear implants in electrosurgery: a systematic review of the literature. Dermatol Surg. 2017;43(6):775-783.	Literature Review	n/a	n/a	n/a	n/a	Use bipolar electrosurgery above clavicles when a cochlear implant is present. Monopolar maybe used below clavicle	VA

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148	Frampton SJ, Mitchell TE. Surgical safety issues relating to the use of diathermy in patients with cochlear implants: the patient's perspective. Cochlear Implants Int. 2014;15(1):48-52.	Qualitative	50 adults and the parents of 50 children with cochlear implants	n/a	n/a	Amount of knowledge on the interaction of cochlear implant and electrosurgery	Patients and surgeons need education on the use of electrosurgery when the patient has a cochlear implant.	IIIB
149	Law SC, Wong JC, Cheung HY, Chung CC, Li MK. Colonic injury from electric arcing: a significant complication of argon plasma coagulation. Hong Kong Med J. 2009;15(3):227-229.	Case Report	n/a	n/a	n/a	n/a	Describes a case of capacitive coupling using AEC.	VC
150	Sachdeva A, Pickering EM, Lee HJ. From electrocautery, balloon dilatation, neodymium- doped:yttrium-aluminum-garnet (Nd:YAG) laser to argon plasma coagulation and cryotherapy. J Thorac Dis. 2015;7(Suppl 4):S363-S379.	Expert Opinion	n/a	n/a	n/a	n/a	Provides guidance on argon gas flow rates	VB
151	Mendelson BJ, Feldman JM, Addante RA. Argon embolus from argon beam coagulator. J Clin Anesth. 2017;42:86-87.	Case Report	n/a	n/a	n/a	n/a	Describes a case in which a gas embolism developed during the use of AEC	VB
152	Shaw Y, Yoneda KY, Chan AL. Cerebral gas embolism from bronchoscopic argon plasma coagulation: a case report. Respiration. 2012;83(3):267-270.	Case Report	n/a	n/a	n/a	n/a	Case report of a patient who expired from cerebral systemic gas embolization during bronchoscopic AEC use.	VA
153	Sutton C, Abbott J. History of power sources in endoscopic surgery. J Minim Invasive Gynecol. 2013;20(3):271-278.	Expert Opinion	n/a	n/a	n/a	n/a	Historical perspective on energy devices for the OR.	VC
154	Ahrens PM, Siddiqui NA, Rakhit RD. Pacemaker placement and shoulder surgery: is there a risk? Ann R Coll Surg Engl. 2012;94(1):39-42.	Qualitative	17 surgeons, 8 residents	n/a	n/a	Use of electrosurgery in the presence of a pacemaker	Education is needed on risks associated with shoulder surgery in patients with a pacemaker	IIIC
155	Feldman LS, Fuchshuber P, Jones DB, Mischna J, Schwaitzberg SD; FUSE (Fundamental Use of Surgical EnergyTM) Task Force. Surgeons don't know what they don't know about the safe use of energy in surgery. Surg Endosc. 2012;26(10):2735-2739.	Qualitative	48 surgeons and 27 residents	n/a	n/a	Correct answers on test regarding electrosurgery and associated complications.	Surgeons have a knowledge gap regarding the safe use of electrosurgery devices and education is needed.	IIIB
156	AlNomair N, Nazarian R, Marmur E. Complications in lasers, lights, and radiofrequency devices. Facial Plast Surg. 2012;28(3):340-346.	Expert Opinion	n/a	n/a	n/a	n/a	Education is needed to prevent the complications associated with improper use of energy devices	VB

REFERENCE #	CITATION	EVIDENCE TYPE	SAMPLE SIZE/ POPULATION	INTERVENTION(S)	CONTROL/ COMPARISON	OUTCOME MEASURE(S)	CONCLUSION(S)	CONSENSUS SCORE
157	Brown J, Blank K. Minimally invasive endometrial ablation device complications and use outside of the manufacturers' instructions. Obstet Gynecol. 2012;120(4):865-870	Case Report	n/a	n/a	n/a	n/a	Additional education is needed on proper use of devices for endometrial ablation	VC
158	Surve R, Madhusudan S, Sriganesh K. Electrocautery interference with intraoperative capnography during neurosurgery. J Clin Monit Comput. 2014;28(4):429-430.	Case Report	n/a	n/a	n/a	n/a	Education on electrocautery induced artifact will help prevent diagnostic confusion and unneeded treatments.	VB