



Title: Malignant Hyperthermia	
Document #: 6489	Issuing Authority: BP Clinical Programs/Chief Nurse Executive, Administration
Last Revised Date: 11/29/2019	Version Number: 2.1 (Current)

PURPOSE:

This policy outlines the safe management of patients with known risk for Malignant Hyperthermia (MH) and the management of a MH crisis at the Brant Community Healthcare System (BCHS).

POLICY STATEMENT:

Malignant Hyperthermia can present whenever inhalation anaesthetics and/or succinylcholine are used.

While most cases of MH occur during general anaesthesia, it has occurred up to 12 hours post anaesthetic.

Those patients with a family history of MH who have had previous anaesthetics without a problem **are still at risk**. Deaths have occurred even though patients have undergone multiple prior uneventful surgeries.

DEFINITION (S):**Malignant Hyperthermia:**

A potentially fatal, rare genetic disorder characterized by a hypermetabolic state usually triggered by potent halogenated inhalation anesthetic agents and depolarizing skeletal muscle relaxants (ORNAC, 2017) Early Signs of MH include hypercarbia, sinus tachycardia, masseter muscle rigidity (MMR), generalized muscle rigidity and/or oxygen desaturation.

PROCEDURE:

- 1) **Care of the Patient Pre-operatively (Surgical and/or Labour and Delivery Patients):**
 - a. Perioperative registered nurses shall assess patients pre-operatively for possible MH risk factors such as a family history of a severe reaction or unexplained death during anesthesia.
 - b. Patients with a known risk for MH who require surgery will be scheduled as the first case in the morning when possible.
 - c. To ensure an adequate supply of equipment and drugs, **only one (1) patient with a known risk for MH should be scheduled per day**. If the necessity arises for more than one patient with known risk for MH to be scheduled per day, the subsequent surgeries will be cancelled should a patient experience a MH crisis.

- 2) **Care of the Post-Operative Patient with Known Risk for Malignant Hyperthermia Crisis:**

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- a. The patient should be transferred from the Operating Room (OR) on the hyper/hypothermia blanket, on a hospital bed. In the event that the patient arrived for surgery on a stretcher, the Operating Room Assistant (ORA) shall deliver a bed to the OR for post-operative care of the MH patient.
- b. The OR/Labour and Delivery (L&D) MH cart and hypothermia blanket will accompany the postoperative patient from the OR to the Post Anaesthetic Care Unit (PACU) for the recovery phase.
- c. Vital signs (including temperature) will be monitored every fifteen (15) minutes in PACU and L&D until discharge criteria are met or as specified by the Anaesthesiologist.
- d. If the anesthetic was uneventful, and no anesthetic drugs that trigger MH were used, continue to monitor the patient for a total of two (2) hours in PACU, L&D and Day Surgery.

3) Post-Operative Care Of the Day Surgery Patient with Known Risk for Malignant Hyperthermia Crisis:

- a. Discharge of day surgery patients may be possible after two (2) hours, providing all other discharge criteria are met (Malignant Hyperthermia Association, 2015).
- b. An intravenous catheter will remain in situ until discharge for day surgery patients.

4) Post-Operative Care Of the In-Patient with Known Risk for Malignant Hyperthermia Crisis:

- a. Patients with known risk for MH may be cared for post-operatively on a clinical unit.
- b. On the clinical unit, vital signs (including temperature) will be monitored per routine vital sign frequency.
- c. Intravenous (IV) catheter will remain in situ for at least 12 hours post-operatively.
- d. **The Anaesthesiologist will be Notified at Anytime During the First 24 Hours if Any of the Following Symptoms Develop:**
 - i. Tachycardia is present or arrhythmia develops
 - ii. Muscle rigidity develops
 - iii. Oxygen saturation decreases (less than 95%) or oxygen requirements increase
 - iv. Temperature increases 0.5 degrees centigrade in any 15 minute period
 - v. Patient becomes tachypnic, flushed or diaphoretic

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- 5) **Malignant Hyperthermia Crisis in the Operating Room (Intraoperatively):**
- a. The circulating nurse shall inform the OR most responsible nurse (MRN) that a MH crisis is occurring.
 - i. **During off shifts - call Code BLUE.** The code team will assist as required.
 - b. The OR MRN shall assign personnel to bring:
 - i. **MH cart** to the operating room suite (accessed through the OR and/or L&D)
 - ii. Insulin and cold normal saline intravenous bags from the refrigerator, and ice from the freezer or ice machine
 - iii. Code Cart
 - iv. Additional staff as required
 - c. The Anaesthesiologist shall direct the treatment of the MH crisis.
 - d. The Surgeon shall complete the surgery as quickly as possible, or will cover the operative site.
 - e. The OR circulating nurse shall obtain the Vapor- Clean (charcoal) filter from the MH cart and change the disposables. The charcoal filter attaches between the machine and the circuit.
 - f. The “Malignant Hyperthermia Critical Intervention Record” will be utilized to record the details of the crisis.
 - g. The “Malignant Hyperthermia Dantrolene Administration Record” will be utilized to record dantrolene administration.
 - h. The OR MRN shall advise the Critical Care Unit (CCU) regarding potential CCU admission and name of patient’s most responsible physician (MRP). The CCU Intensivist shall assume care of the patient on arrival to CCU.
 - i. Following a MH crisis, the patient should be registered with Malignant Hyperthermia Investigation Unit in Toronto (refer to http://pie.med.utoronto.ca/MH/MH_content/reportMH.html for the most up to date form).
- 6) **Malignant Hyperthermia Crisis Outside of the OR:**
- a. In the event of a MH Crisis outside of the OR call Anaesthesiologist STAT and Code BLUE STAT.
 - b. There are **36 vials of dantrolene (Dantrium) in hospital inventory.**
 - i. **12 vials** are kept in the **OR EL1**
 - ii. **12 vials** in **L&D** on C3
 - iii. **12 vials** in the **CCU** on D5
 - c. The “Malignant Hyperthermia Critical Intervention Record” will be utilized to record the details of the crisis.

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- d. The “Malignant Hyperthermia Dantrolene Administration Record” will be utilized to record dantrolene administration.
- e. The MRN shall advise the Critical Care Unit (CCU) regarding potential CCU admission and name of patient’s most responsible physician (MRP). The CCU Intensivist shall assume care of the patient on arrival to CCU.
- f. Following a MH crisis, the patient should be registered with Malignant Hyperthermia Investigation Unit in Toronto (refer to http://pie.med.utoronto.ca/MH/MH_content/reportMH.html for the most up to date form).

RELATED PRACTICES AND / OR LEGISLATIONS:

N/A

APPENDICES:

Appendix A – Preparation of the Operating Room for the Patient with Known or Suspected Malignant Hyperthermia

Appendix B – Contents of Malignant Hyperthermia Drug Box

Appendix C – Triggering Agents (not to be used) and Safe Agents (may be used)

Appendix D – Reconstitution of dantrolene sodium

Appendix E – Malignant Hyperthermia Cart Monthly Checklist

Appendix F – Malignant Hyperthermia Critical Intervention Record

Appendix G – Malignant Hyperthermia Dantrolene Administration Flowsheet

REFERENCES:

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crisis?search=malignant%20hyperthermia&source=search_result&selectedTitle=1~123&usage_type=default&display_rank=1

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APPENDICES:

Appendix A – Preparation of the Operating Room for the Patient with Known or Suspected Malignant Hyperthermia

PROCEDURE: Set-up of OR Room

- MH cases (known or suspected) will be scheduled for 0800 hours and should be set up the night before whenever possible.
- **Respiratory Therapist (RT):**
 - Converts anaesthetic machine to vapour-free (refer to manufacturer’s instructions for use).
 - All vaporizers are removed from the machine (i.e. sevoflurane, desflurane), and placed on a stainless steel table at the anesthetic end of the Operating Room.
 - Prepares anaesthetic machine with a new breathing circuit, re-breathing bag and mask. The **anaesthetic machine is flushed** with O2 on 100% for a **minimum of fifteen (15) minutes** (a sign is hung on the machine to identify as such).
 - Changes CO2 absorbent.
- **Operating Room Assistants:**
 - Brings MH cart into the OR suite.
 - Hangs MH sign on the OR door.
 - Places hyper/hypothermia blanket is on the OR table and set at 36°C but not turned on.
- **Registered Nurses:**
 - One circulating nurse will be assigned to the room.
 - ECG, BP, Pulse oximeter, 2 temperature probes will be used.
 - Additional monitoring used at the discretion of the Anaesthesiologist.

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Appendix B – Contents of Malignant Hyperthermia Drug Box

It is the responsibility of the OR circulating nurse and L&D MRN to ensure that all MH equipment is replaced and the MH cart is fully stocked. The MH cart shall be checked once per month and after use (See Appendix D).

MALIGNANT HYPERTHERMIA DRUG BOX	
One (1) Malignant Hyperthermia kit to be located in the OR and one in L&D. Contents & expiry dates checked by Pharmacy on a monthly basis or after use.	
CONTENTS	
12	dantrolene 20 mg IV vials in OR MH cart (12 vials dantrolene in L&D & 12 vials in CCU = total of 36 vials)
2	sterile water - 1000 mL bags (non-bacteriostatic agent)
2	dextrose 50% - 50 mL preloaded syringes
5	sodium bicarbonate 8.4% - 50 mL pre-loaded syringes
1	propranolol 1 mg/mL 1 mL vial
3	furosemide 40 mg/2 mL amps
2	calcium chloride 10% - 1 g/10 mL pre loaded syringes
3	lidocaine HCL 2% - 100 mg/5 mL
	regular insulin – refrigerated
5	Cornwall syringes (vented needle taped to package)
5	60 mL luer lock syringes
2	20 mL luer lock syringes
1	Mini drip buretrol IV administration set
1	Secondary IV medication administration set
6	Arterial blood gas kits
2	Blood tubes – 2 each yellow, blue, red, purple tops
4	Millipore 0.22 um filters
5	Each needles, gauge size: 16, 18, 21, 22
4	Each IV catheters, gauge size: 24, 22, 20, 18, 16
3	Cold saline 1000 mL – refrigerated
1	dextrose 5% IV solution 250 mL bag

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Appendix C – Triggering Agents (not to be used) and Safe Agents (may be used):

Triggering Agents: DO NOT USE

Drug Class	Examples Available at the BCHS
All volatile inhalation anesthetics	sevoflurane
	desflurane
Depolarizing Muscle Relaxant	succinylcholine

Safe Agents: May be Used (Not a comprehensive list)

Local anaesthetics	<u>Non-depolarizing muscle relaxants such as:</u>
Barbiturates	atracurium
Opioids	cisatracurium
nitrous oxide	mivacurium
propofol	pancuronium
Benzodiazepines	vecuronium
ketamine	rapacuronium
etomidate	rocuronium

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Appendix D – Reconstitution of dantrolene sodium

- Give 2.5 mg/kg body weight
- Add 60 mL of non-bacteriostatic sterile water to 1 vial of 20 mg dantrolene sodium
- Concentration of reconstituted dantrolene sodium is 0.33 mg/mL

DANTROLENE RECONSTITUTION CHART 20 mg/vial

WEIGHT of patient	5 kg	10 kg	15 kg	20 kg	25 kg	30 kg	35 kg	40 kg	45 kg
DOSAGE (2.5mg/kg)	12.5 mg	25.0 mg	37.5 mg	50 mg	62.5 mg	75 mg	87.5 mg	100 mg	112.5 mg
VOLUME of Reconstituted Solution	37.88 mL	75.76 mL	113.64 mL	151.52 mL	189.4 mL	227.27 mL	265.15 mL	303 mL	337.5 mL
Number of vials needed for reconstitution	1	2	2	3	4	4	5	5	6

WEIGHT of patient	50 kg	55kg	60 kg	65 kg	70 kg	75 kg	80 kg	85 kg	90 kg
DOSAGE (2.5mg/kg)	125 mg	137.5 mg	150 mg	162.25 mg	175 mg	187.5 mg	200 mg	212.5 mg	225 mg
VOLUME of Reconstituted Solution	378.79 mL	416.67 mL	454.55 mL	492.42 mL	530.3 mL	568.18 mL	606.06 mL	643.94 mL	675 mL
Number of vials needed for reconstitution	7	7	8	9	9	10	10	11	12

WEIGHT of patient	95 kg	100 kg	105 kg	110 kg	115 kg	120 kg	125 kg	130 kg	135 kg
DOSAGE (2.5mg/kg)	237.5 mg	250 mg	262.5 mg	275 mg	287.5 mg	300 mg	312.5 mg	325 mg	337.5 mg
VOLUME of Reconstituted Solution	719.7 mL	757.58 mL	795.45 mL	833.33 mL	871.21 mL	909.09 mL	946.97 mL	984.85 mL	1012.5 mL
Number of vials needed for reconstitution	12	13	14	14	15	15	16	17	17

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Appendix E – Malignant Hyperthermia Cart Monthly Checklist

THE BRANTFORD GENERAL HOSPITAL- SURGICAL SUITE MALIGNANT HYPERTHERMIA CART – MONTHLY CHECKLIST												
MALIGNANT HYPERTHERMIA KIT - CONTENTS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC
TOP OF CART												
Malignant hyperthermia caution signs												
Malignant hyperthermia blanket												
CO2 absorbent												
Portable thermometer												
Rectal probe												
DRAWER 1												
12 – dantrolene sodium 20 mg vials												
2 pairs - Vapor-Clean charcoal filters												
2 – dextrose 50% 50 mL syringes												
5 – 50 mL sodium bicarbonate 8.4%												
1 – Mini drip buretrol solution set												
1 – Secondary medication set												
6 – Arterial blood gas kits or ABG syringes												
5 – each needles, gauge size: 16, 18, 21, 22												
4 – each IV catheters, gauge size: 16, 18, 20, 22, 24												
2 – each of Blood tubes – yellow, blue, red, purple tops												
4 – Millipore 0.22 filters												
4 – Specimen bags												

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**THE BRANTFORD GENERAL HOSPITAL- SURGICAL SUITE
MALIGNANT HYPERTHERMIA CART – MONTHLY CHECKLIST**

DRAWER 2	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC
2 – sterile water 1000 mL IV bags (non-bacteriostatic)												
1 – propranolol 1 mg/mL												
3 – furosemide 40 mg/2 mL												
1 – lidocaine HCL 2% 100 mg/ 5 mL												
2 – calcium chloride 10% 1 g/10 mL pre- loaded syringes												
1 – dextrose 5% IV solution 250 mL bag												
2 – Cornwall syringes (with vented 16 gauge needle taped to pkg) OR 2 – Transfer sets												
12 – 60 mL luer lock syringes												
12 – Mini-spikes												
2 – 20 mL luer lock syringes												

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**THE BRANTFORD GENERAL HOSPITAL- SURGICAL SUITE
MALIGNANT HYPERTHERMIA CART – MONTHLY CHECKLIST**

DRAWER 3	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC
1 – of each masks: #3, 4, 5 & pediatric: 1 small, 1 medium												
1 – Each of NG tubes: #12, 14, 16, 18												
1 – Irrigation tray with piston syringe for NG irrigation												
2 – Toomey irrigation syringe												
1 – Drip-catheter tray												
1 – Each 3-way irrigation foley catheters sizes #16, 18, 20, 24												
1 – Urine metered bag												
4 – Large clear bags for ice												
4 – Small clear bags for ice												
1 – Bucket in room for ice												
2 – Esophageal temperature probes												
1 – Transducer kit (percutaneous)												
1 – ¾ sterile sheet (for wound)												
2 – Sterile jars												
3 – Cornwall syringes (extra)												

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THE BRANTFORD GENERAL HOSPITAL MALIGNANT HYPERTHERMIA CART – MONTHLY CHECKLIST												
DRAWER 4	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC
1 – Each of paediatric & adult new circle tubing												
1 – Each of oral airways #6, 7, 8, 9, 10, 11												
1 – Each of CVP kits: Triple lumen 7 French, single lumen 16ga												
1 – Each Ambu bags: Adult & pediatric												
REFRIGERATOR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC
Regular insulin - 1 each												
3 – Normal Saline 1000 mL IV bags												

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Appendix F – Malignant Hyperthermia Critical Intervention Record

 Malignant Hyperthermia Critical Intervention Record		Patient Identification Label			
Time: _____ Date: _____		Circle: Adult / Pediatric Weight: _____			
Staff Assignments: Circulating Nurse: _____ Dantrolene Nurse: _____ Other: _____		Anesthesiologist: _____ Medication Nurse: _____ Cooling Nurse: _____ Other: _____			
A ASSESSMENT OF MALIGNANT HYPERTHERMIA – RAPID ABC (including level of consciousness)					
<u>Signs of Malignant Hyperthermia</u>		<u>Sudden/Unexpected Cardiac Arrest in Young Patients</u>		<u>Trismus or Masseter Spasm with Succinylcholine</u>	
<input type="checkbox"/> Increased ETCO ₂ <input type="checkbox"/> Trunk or limb rigidity <input type="checkbox"/> Masseter spasm/trismus <input type="checkbox"/> Tachycardia/tachypnea <input type="checkbox"/> Acidosis <input type="checkbox"/> Increased temperature		<input type="checkbox"/> Presume hyperkalemia and initiate treatment <input type="checkbox"/> Measure CK and ABGs until normal (urine myoglobin testing is performed offsite, results take 3-7 days) <input type="checkbox"/> Consider dantrolene <input type="checkbox"/> Usually secondary to occult myopathy (e.g. muscular dystrophy) <input type="checkbox"/> Resuscitation may be difficult and prolonged		<input type="checkbox"/> Early sign of MH in many patients <input type="checkbox"/> If limb rigidity, begin dantrolene <input type="checkbox"/> For emergent procedures, continue with non-triggering agents; consider dantrolene <input type="checkbox"/> Follow CK for 36 hours (urine myoglobin testing is performed offsite, results take 3-7 days) <input type="checkbox"/> Observe in the Critical Care Unit for at least 12 hours	
B IMMEDIATE ACTIONS					
<input type="checkbox"/> Stop volatile agents and succinylcholine <input type="checkbox"/> Call for help (and/or Code Blue) <input type="checkbox"/> Notify Surgeon/Anesthesiologist <input type="checkbox"/> Halt the procedure ASAP (if an emergent procedure, use non-triggers)		<input type="checkbox"/> Hyperventilate with 100% O ₂ at 10 L/min or more via bag-valve-mask with ETCO ₂ monitoring (3-4x normal minute volume) <input type="checkbox"/> Use anesthesia machine ventilator immediately and set for high minute ventilation (e.g. 20-30 breaths/minute x 10 mL/kg) with high fresh oxygen flow			
C CIRCULATORY ACCESS AND COOLING					
<input type="checkbox"/> 2 large bore IVs <input type="checkbox"/> Cold NS for IV infusion		<input type="checkbox"/> Foley catheter insertion <input type="checkbox"/> Temperature monitoring <input type="checkbox"/> Apply ice to surface (discontinue when temp less than 38 degrees Celsius) <input type="checkbox"/> Consider peritoneal lavage if very hyperthermic			
D DANTROLENE 2.5 mg/kg rapid IV					
Use "Dantrolene Administration Flowsheet"					
DRUGS					
Indication	Drug/Dose/Route	Time	Time	Time	Time
Metabolic Acidosis and/or hyperkalemia	sodium bicarbonate 1-2 mEq/kg IV/IO <small>(maximum dose 30 mEq) Dose: _____</small>				
Hyperkalemia	calcium chloride 10 mg/kg IV/IO <small>(maximum dose 2000 mg) Dose: _____</small>				
Hyperkalemia (ADULTS)	Regular insulin 10 units IV AND dextrose 50% 50 mL IV				
Hyperkalemia (PEDIATRICS)	Regular insulin 0.1 units/kg <small>(maximum dose 10 units)</small> AND dextrose 50% 4 mL/kg <small>(maximum dose 50 mL)</small>				
	IV Fluids				

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Appendix G – Malignant Hyperthermia Dantrolene Administration Flowsheet

		Malignant Hyperthermia Dantrolene Administration Flowsheet		Patient Identification Label	
Give dantrolene 2.5 mg/kg body weight					
<u>Patient Weight (kg):</u>	<u>Dose (mg):</u> Weight in kg x 2.5 mg/kg =	<u>Volume of Reconstituted Solution (mL):</u> Dose in mg x 3 =	<u>Number of Vials Needed:</u>		
MIXING					
<input type="checkbox"/> Reconstitute with 60 mL of non-bacteriostatic sterile water per 1 vial of 20 mg dantrolene sodium (concentration of reconstituted solution is 0.33 mg/mL)			<input type="checkbox"/> Shake the vial for approximately 20 seconds or until the solution is clear		
<input type="checkbox"/> Inject the sterile water into the vial of dantrolene slowly			<input type="checkbox"/> Inject rapidly into the closest port to the patient using aseptic technique		
ADMINISTRATION					
Vial Number (Check Box if WHOLE 20 mg Vial Given)	Cumulative Dose of WHOLE Vials (mg / mL)	Partial Vial Volume Needed (volume needed – volume of # of WHOLE vials) =	Time	Initials	
<input type="checkbox"/> Vial #1	20 mg / 60 mL				
<input type="checkbox"/> Vial #2	40 mg / 120 mL				
<input type="checkbox"/> Vial #3	60 mg / 180 mL				
<input type="checkbox"/> Vial #4	80 mg / 240 mL				
<input type="checkbox"/> Vial #5	100 mg / 300 mL				
<input type="checkbox"/> Vial #6	120 mg / 360 mL				
<input type="checkbox"/> Vial #7	140 mg / 420 mL				
<input type="checkbox"/> Vial #8	160 mg / 480 mL				
<input type="checkbox"/> Vial #9	180 mg / 540 mL				
<input type="checkbox"/> Vial #10	200 mg / 600 mL				
<input type="checkbox"/> Vial #11	220 mg / 660 mL				
<input type="checkbox"/> Vial #12	240 mg / 720 mL				
<input type="checkbox"/> Vial #13	260 mg / 780 mL				
<input type="checkbox"/> Vial #14	280 mg / 840 mL				
<input type="checkbox"/> Vial #15	300 mg / 900 mL				
<input type="checkbox"/> Vial #16	320 mg / 960 mL				
<input type="checkbox"/> Vial #17	340 mg / 1020 mL				
<input type="checkbox"/> Vial #18	360 mg / 1080 mL				
<input type="checkbox"/> Vial #19	380 mg / 1140 mL				
<input type="checkbox"/> Vial #20	400 mg / 1200 mL				
<input type="checkbox"/> Vial #21	420 mg / 1260 mL				
<input type="checkbox"/> Vial #22	440 mg / 1320 mL				
<input type="checkbox"/> Vial #23	460 mg / 1380 mL				
<input type="checkbox"/> Vial #24	480 mg / 1440 mL				
<input type="checkbox"/> Vial #25	500 mg / 1500 mL				
TOTAL VOLUME GIVEN (mL):					
Administering Nurse Signature	Initials	Administering Nurse Signature	Initials		

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