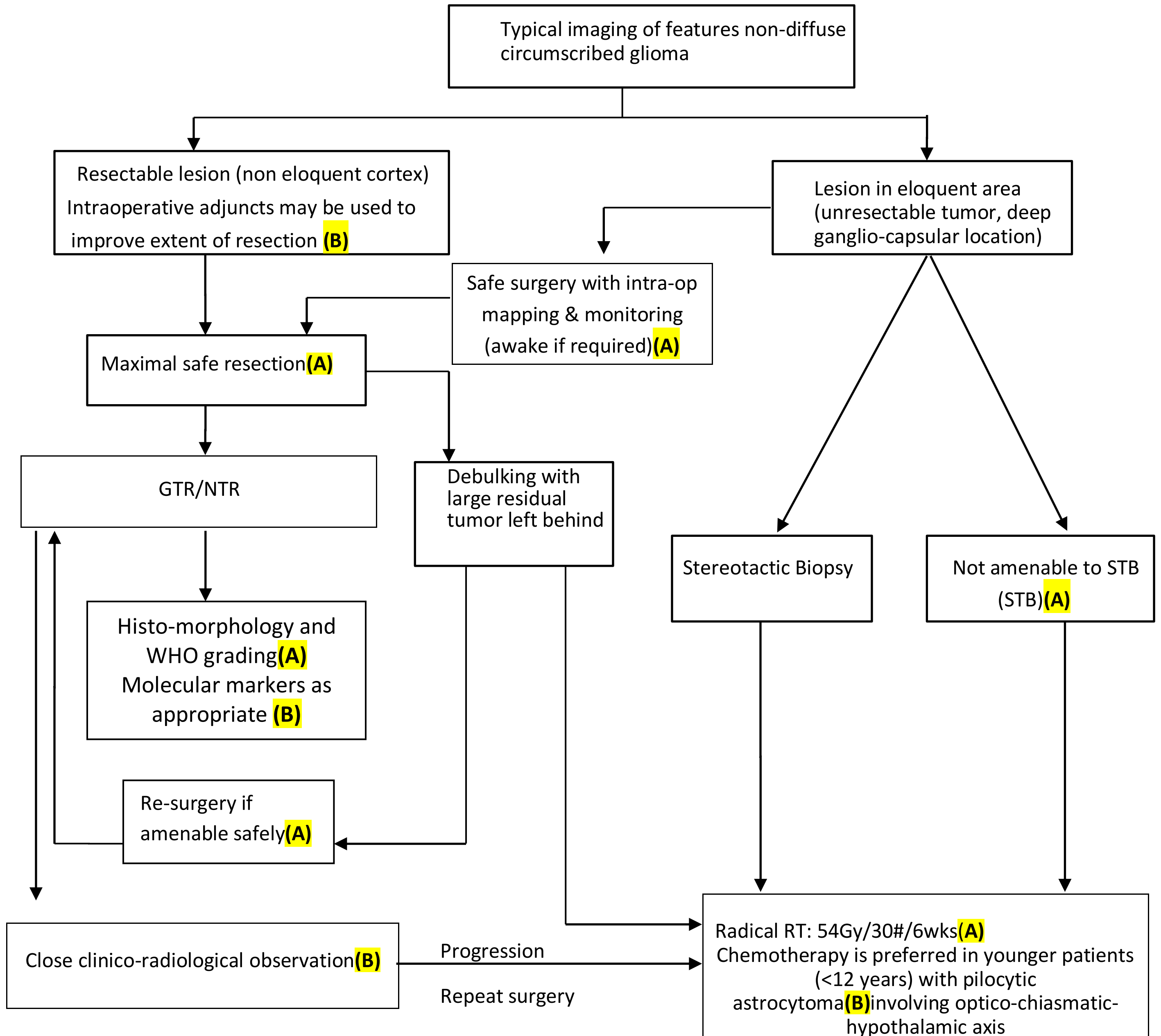
Non-Diffuse Circumscribed Glioma

(Pilocytic Astrocytoma/DNET/Ganglioglioma/PXA/Glioneuronal Tumor/Neuro-Epethelial Tumor NOS)



GTR=gross total resection

NTR=near total resection

RT=radiotherapy

A= MANDATORY

B= OPTIMAL

C= OPTIONAL

*NF-1 with optic pathway glioma with typical imaging- no biopsy is required

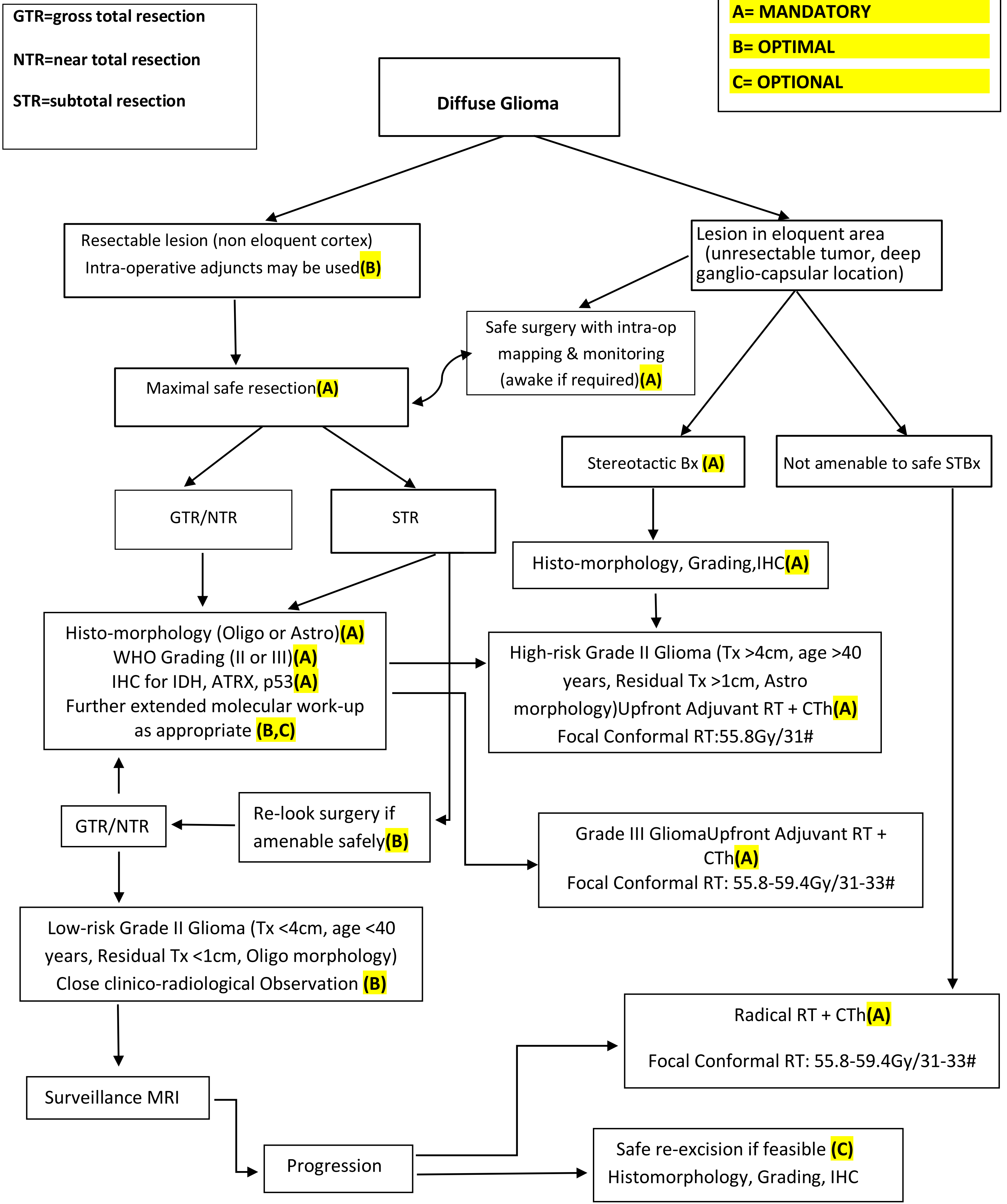
*NF-1 pts with uncommon sites and atypical imaging features - biopsy should definitely be considered

*BRAF fusion & mutation as appropriate (REFER TO PATHOLOGY SECTION)

*SEGA in pts with Tuberous Sclerosis is a separate entity and should betreated with mTOR inhibitors**(B)**

Recommended chemotherapy regimens in Pediatric Low-Grade Glioma

Drugs	Dose	Days and Route
Regimen A- 52 weeks duration		
Carboplatin	550mg/m^2or 18mg/kg	Day 1 IV every 3 weekly
Vincristine	1.5mg/m^2or 0.046mg/kg	Day 1,8 and 15 IV for 13 weeks Day 1 only after that till 52 weeks
OR		
Regimen B- 52 cycles given every week		
Vinblastine	6mg/m^2	Day 1 only weekly IV
OR		
Regimen C- PCV Regimen- (6-9 cycles every 6-weekly)		
Procarbazine	100mg/m^2	Day 8 -21 orally
Vincristine	1.5mg/m^2	Day 8 and 29 IV
Lomustine	100mg/m^2	Day 1 only orally
OR		
Regimen D- Bevacizumab± Irinotecan: Recurrence/Progression (6-12 cycles every 2-weekly)		
Bevacizumab	5-10mg/kg	Day 1 only IV
Irinotecan	125mg/m2	Day 1 only IV



Diffuse Lower Grade (Grades II-III) Glioma (LrGG)
GTR=gross total resection
NTR=near total resection
STR=subtotal resection
A= MANDATORY
B= OPTIMAL
C= OPTIONAL
Diffuse Glioma
Resectable lesion (non eloquent cortex)
Intra-operative adjuncts may be used(B)
Lesion in eloquent area (unresectable tumor, deep ganglio-capsular location)
Safe surgery with intra-op mapping & monitoring (awake if required)(A)
Maximal safe resection(A)
Stereotactic Bx (A)
Not amenable to safe STBx
GTR/NTR
STR
Histo-morphology, Grading,IHC(A)
Histo-morphology (Oligo or Astro)(A)
WHO Grading (II or III)(A)
IHC for IDH, ATRX, p53(A)
Further extended molecular work-up as appropriate (B,C)
High-risk Grade II Glioma (Tx >4cm, age >40 years, Residual Tx >1cm, Astro morphology)Upfront Adjuvant RT + CTh(A)
Focal Conformal RT:55.8Gy/31#
GTR/NTR
Re-look surgery if amenable safely(B)
Grade III GliomaUpfront Adjuvant RT + CTh(A)
Focal Conformal RT: 55.8-59.4Gy/31-33#
Low-risk Grade II Glioma (Tx <4cm, age <40 years, Residual Tx <1cm, Oligo morphology)
Close clinico-radiological Observation (B)
Radical RT + CTh(A)
Focal Conformal RT: 55.8-59.4Gy/31-33#
Surveillance MRI
Progression
Safe re-excision if feasible (C)
Histomorphology, Grading, IHC

Chemotherapy regimens for Diffuse LrGG

Concurrent chemotherapy during RT

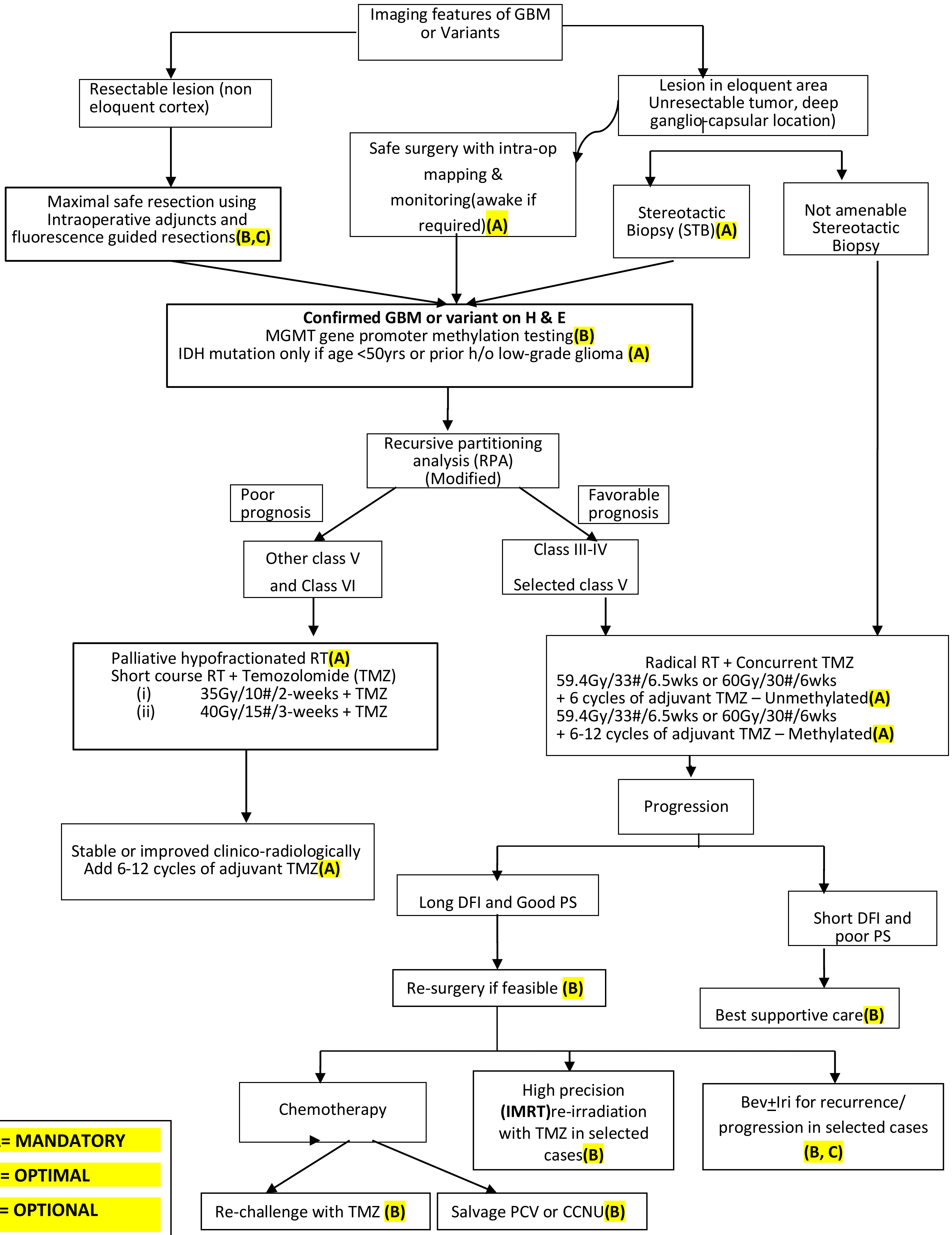
Temozolomide (TMZ): 75mg/m2 per orally daily throughout the course of RT with anti-emetic and PCP prophylaxis

Adjuvant chemotherapy following RT

Temozolomide: 150-200mg/m2 D1-D5 per orally cycled 4-weekly for 12 cycles

Alternative adjuvant chemotherapy regimen

Drugs	Dose	Days and Route
RTOGPCV Regimen (6 cycles every 6-weekly)		
Procarbazine	100mg/m^2	Day 8 -21 orally
Vincristine	1.5mg/m^2	Day 8 and 29 IV
Lomustine	100mg/m^2	Day 1 only orally
OR		
MRC-UK PCV Regimen (6 cycles every 6-weekly)		
Procarbazine	100mg/m^2	Days 1-10 orally
Vincristine	1.5mg/m^2	Day 1 only IV
Lomustine	100mg/m^2	Day 1 only orally
OR		
Single agent CCNU (6 cycles every 6-weekly)		
CCNU	100mg/m2	Day 1 only orally



Glioblastoma (GBM)
Imaging features of GBM or Variants
Resectable lesion (non eloquent cortex)
Lesion in eloquent area Unresectable tumor, deep ganglio-capsular location)
Safe surgery with intra-op mapping & monitoring(awake if required)(A)
Maximal safe resection using Intraoperative adjuncts and fluorescence guided resections(B,C)
Stereotactic Biopsy (STB)(A)
Not amenable Stereotactic Biopsy
Confirmed GBM or variant on H & E
MGMT gene promoter methylation testing(B)
IDH mutation only if age <50yrs or prior h/o low-grade glioma (A)
Recursive partitioning analysis (RPA) (Modified)
Poor prognosis
Favorable prognosis
Other class V and Class VI
Class III-IV Selected class V
Palliative hypofractionated RT(A)
Short course RT + Temozolomide (TMZ)
(i) 35Gy/10#/2-weeks + TMZ
(ii) 40Gy/15#/3-weeks + TMZ
Radical RT + Concurrent TMZ
59.4Gy/33#/6.5wks or 60Gy/30#/6wks
+ 6 cycles of adjuvant TMZ – Unmethylated(A)
59.4Gy/33#/6.5wks or 60Gy/30#/6wks
+ 6-12 cycles of adjuvant TMZ – Methylated(A)
Stable or improved clinico-radiologically
Add 6-12 cycles of adjuvant TMZ(A)
Progression
Long DFI and Good PS
Short DFI and poor PS
Re-surgery if feasible (B)
Best supportive care(B)
Chemotherapy
High precision (IMRT)re-irradiation with TMZ in selected cases(B)
Bev±Iri for recurrence/ progression in selected cases (B, C)
Re-challenge with TMZ (B)
Salvage PCV or CCNU(B)
A= MANDATORY
B= OPTIMAL
C= OPTIONAL

Chemotherapy regimens for GBM

Concurrent chemotherapy during RT

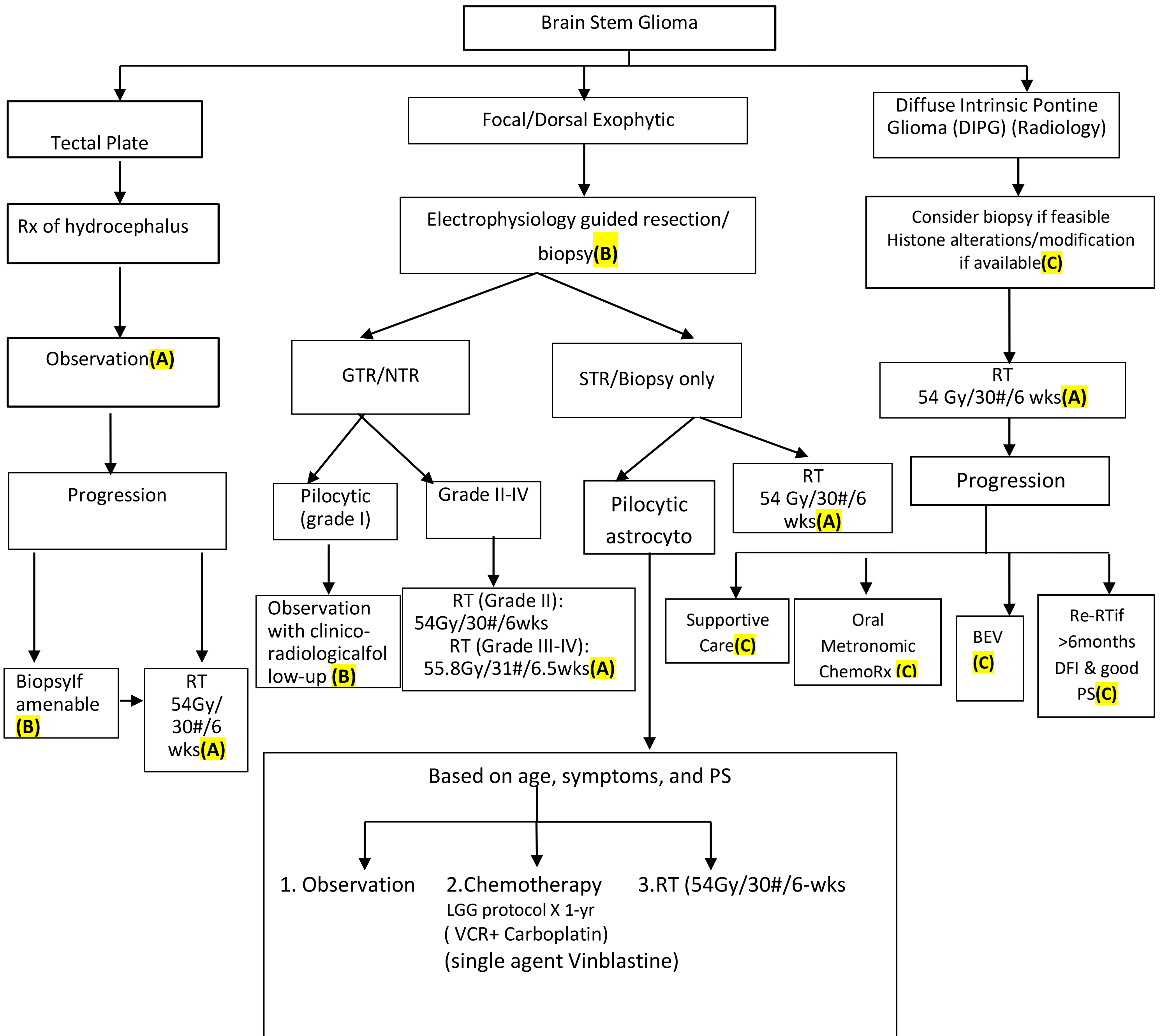
Temozolomide (TMZ): 75mg/m2 per orally daily throughout the course of RT with anti-emetic and PCP prophylaxis

Adjuvant chemotherapy following RT

Temozolomide: 150-200mg/m2 D1-D5 per orally cycled 4-weekly for 6-12 cycles

Salvage chemotherapy regimens for recurrent/progressive GBM

Drugs	Dose	Days and Route
RTOG-PCV Regimen (6 cycles every 6-weekly)		
Procarbazine	100mg/m^2	Day 8 -21 orally
Vincristine	1.5mg/m^2	Day 8 and 29 IV
Lomustine	100mg/m^2	Day 1 only orally
OR		
MRC PCV Regimen (6 cycles every 6-weekly)		
Procarbazine	100mg/m^2	Days 1-10 orally
Vincristine	1.5mg/m^2	Day 1 only IV
Lomustine	100mg/m^2	Day 1 only orally
OR		
Salvage CCNU (6 cycles every 6-weekly)		
CCNU	100mg/m2	Day 1 only orally
OR		
Bevacizumab± Irinotecan: (6-12 cycles every 2-weekly)		
Bevacizumab	5-10mg/kg	Day 1 only IV
Irinotecan	125mg/m2	Day 1 only IV



A= MANDATORY

B= OPTIMAL

C= OPTIONAL

Ependymoma

Ependymal tumor after maximal safe resection

→ Low grade Ependymoma (WHO grade I- II) Residual tumor present

- YES – 2nd look surgery if feasible consider safe re-excision **(B)**

  If 2nd look surgery is not safe Post-operative adjuvantfocal conformal RT 54Gy/30#/6wks**(A)**

- NO: Amenable for Observation &close follow-up**(B)**

→ High-grade ependymoma (anaplastic grade III)

→ Neuraxis staging: MRI spine CSF cytology

- Negative MRI spine and CSF → **Post operative adjuvant focal conformal RT(A)**
  - 59.4Gy/33#/6½ weeks
  - 55.8Gy/31#/6wks in younger children and/or tumours in close in close proximity to critical structures like brainstem, optic apparatus, etc
- Positive MRI spine and/or CSF → Treat like embryonal CNS tumour with CSI + local tumour boost + adjuvant chemotherapy**(A)**

→ **Progression**

- Re surgery if not causing morbidity**(A)** → Re-irradiation if ≥2yrs since primary RT **(B)**
- Salvage Chemotherapy or Metronomic Chemotherapy**(C)**
- Re-irradiation (if primary course of irradiation ≥2yrs ago) **(B)**

1. High Grade (Gr III):
   Children > 18months →RT
   Children < 18months →Chemotherapy
2. Supratentorial RELA fusion +ve - Poor prognosis
   Posterior Fossa EPN A – Poor prognosis
   Posterior Fossa EPN B – Good prognosis
3. Spinal EPN – Good prognosis

A= MANDATORY

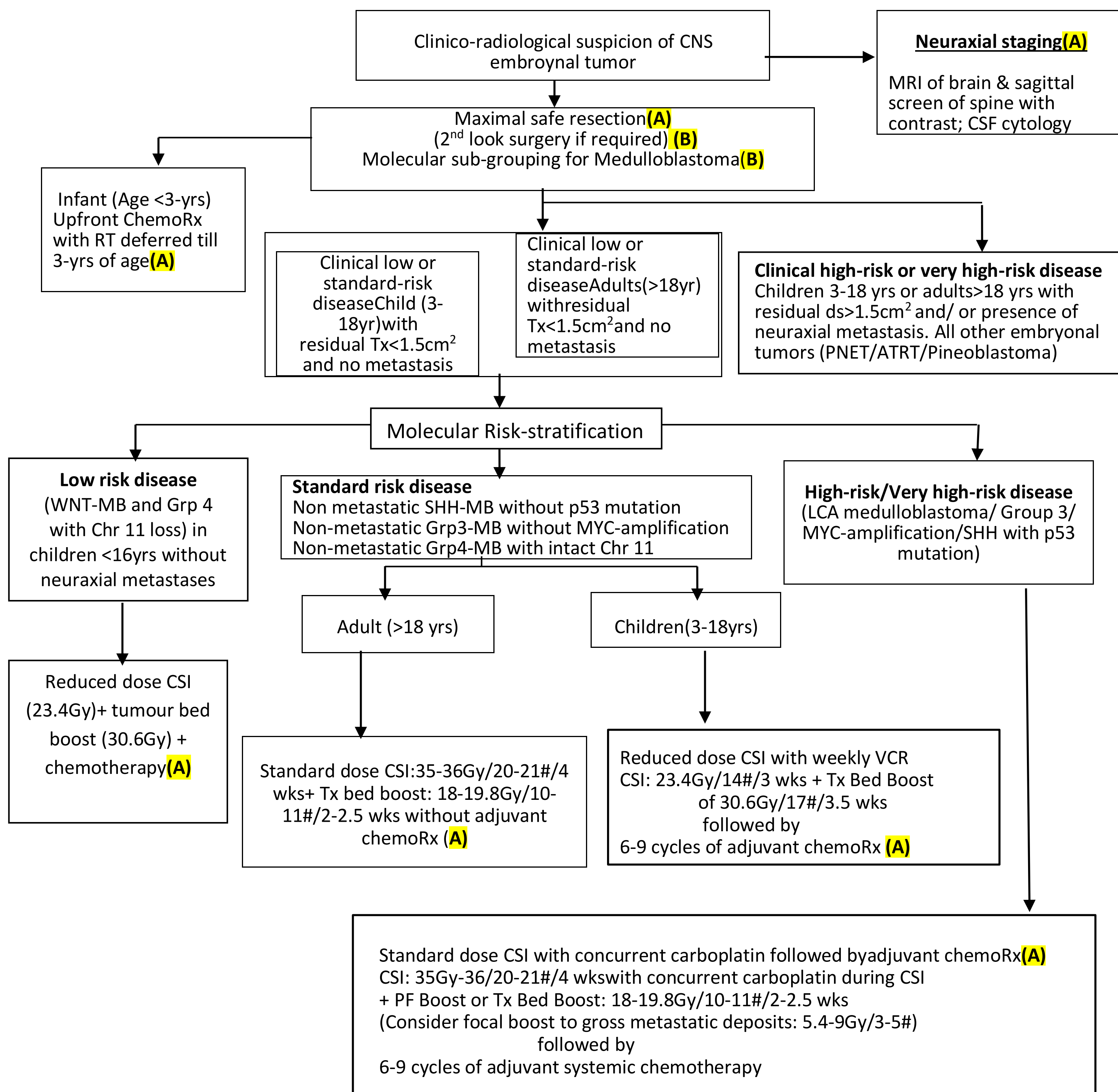
B= OPTIMAL

C= OPTIONAL

Spinal ependymomas: follow similar algorithm as brain, but with reduced doses of RT

Recommended chemotherapy regimens in Ependymoma

Drugs	Dose	Days and Route
Baby Brain Protocol		
For infants (<3 years): every 4-weekly for 12 cycles		
Cyclophosphamide	1000mg/m^2	Day 1 only IV
Carboplatin	565mg/m^2	Day 1 only IV
Etoposide	150mg/m^2	Days 1-3 IV
Salvage Chemotherapy		
Regimen A- VCE chemotherapy (every 3-weekly for 6 cycles)		
Vincristine	1.5mg/m^2	Day 1 only IV
Cisplatin	30mg/m^2	Days 1-3 IV
Etoposide	150mg/m^2	Days 1-3 IV
OR		
Regimen B- ICE chemotherapy (every 3-weekly for 6 cycles)		
Ifosfamide	1500mg/m^2	Days 1-5 IV
Carboplatin	600mg/m^2	Day 1 only IV
Etoposide	100mg/m^2	Days 1-3 IV



A= MANDATORY

B= OPTIMAL

C= OPTIONAL

Chemotherapy regimen for CNS Embryonal Tumors

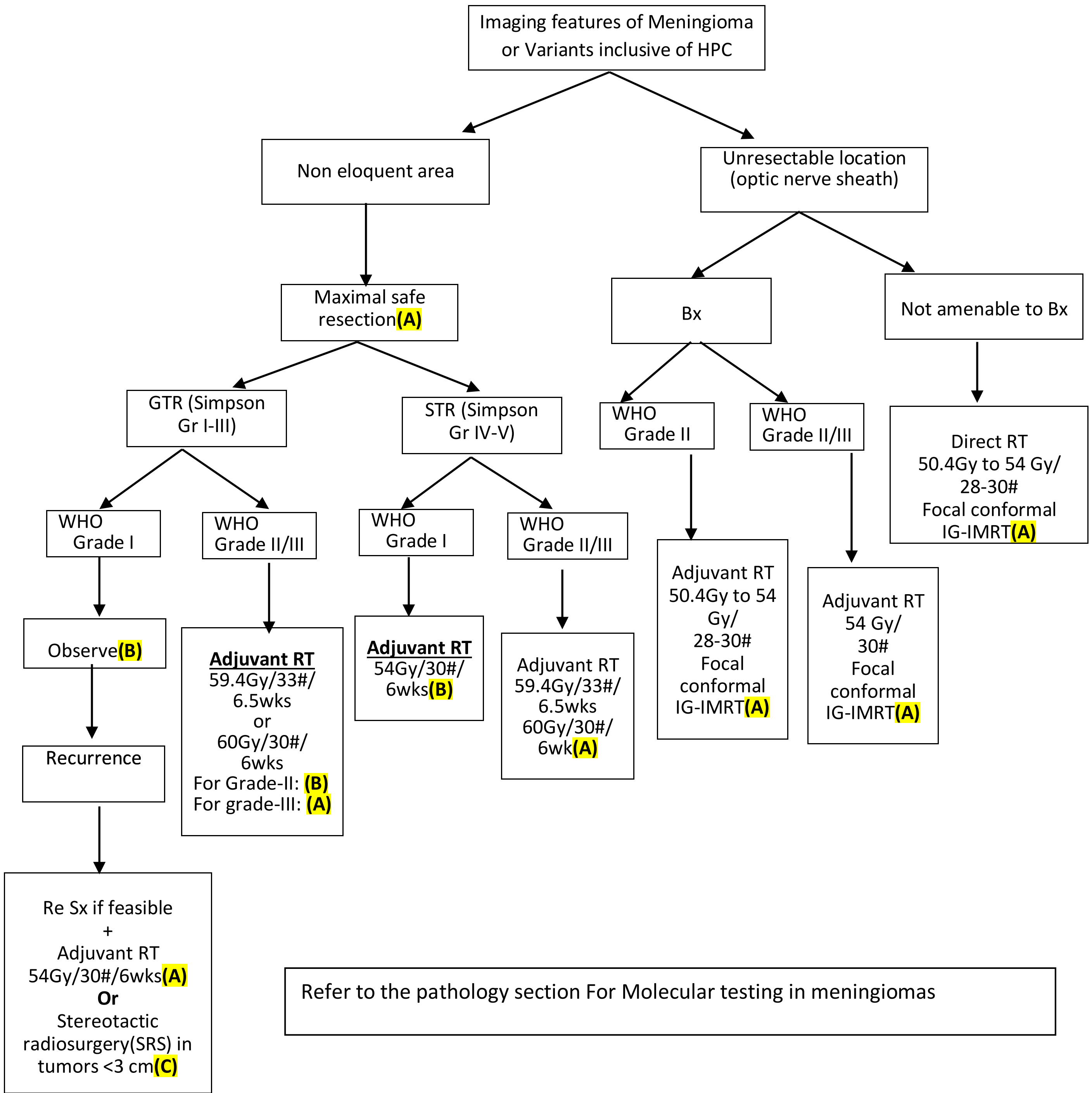
Concurrent chemotherapy during RT

1. Standard-risk disease: Inj Vincristine 1.5mg/m^2 IV weekly for 6-7 weeks during RT
2. High-risk/very high-risk: Inj Carboplatin 35mg/m2 IV daily for 1st 15 days (of CSI) 1-4 hours prior to RT

Adjuvant systemic chemotherapy regimens (any

Drugs	Dose	Days and Route
For children (>3-years) and adults		
Regimen A- Packer's (6-9 cycles every 4-weekly)		
Cisplatin	75mg/m^2	Day 1 only IV
Lomustine	75mg/m^2	Day 1 only orally
Vincristine	1.5mg/m^2	Days 1,8 and 15 IV
OR		
Regimen B- Packer's (6 cycles every 4-weekly)		
Cisplatin	75mg/m^2	Day 1 only IV
Cyclophosphamide	1000mg/m^2	Days 1 and 2 IV
Vincristine	1.5mg/m^2	Days 1,8 and 15 IV
OR		
SJMB96 Protocol (4-cycles every 4-weekly)		
Cisplatin	75mg/m^2	Day 1 onlyin alternate cycle IV
Cyclophosphamide	2000mg/m^2	Days 2 and 3 IV
Vincristine	1.5mg/m^2	Day 1 only IV
To be followed by stem cell rescue after each cycle		
OR		
CET Protocol (6 cycles every 3-weekly)		
Cisplatin	75mg/m^2	Day 1 onlyin alternate cycle IV
Cyclophosphamide	1000mg/m^2	Days 1 and 2 IV
Vincristine	1.5mg/m^2	Days 1 and 8 IV
For infants (<3 years): every 4-weekly for 12 cycles		
Baby Brain Protocol		
Cyclophosphamide	1000mg/m^2	Day 1 only IV
Carboplatin	565mg/m^2	Day 1 only IV
Etoposide	150mg/m^2	Days 1-3 IV

Imaging features of Meningioma or Variants including Hemangiopericytoma (HPC)

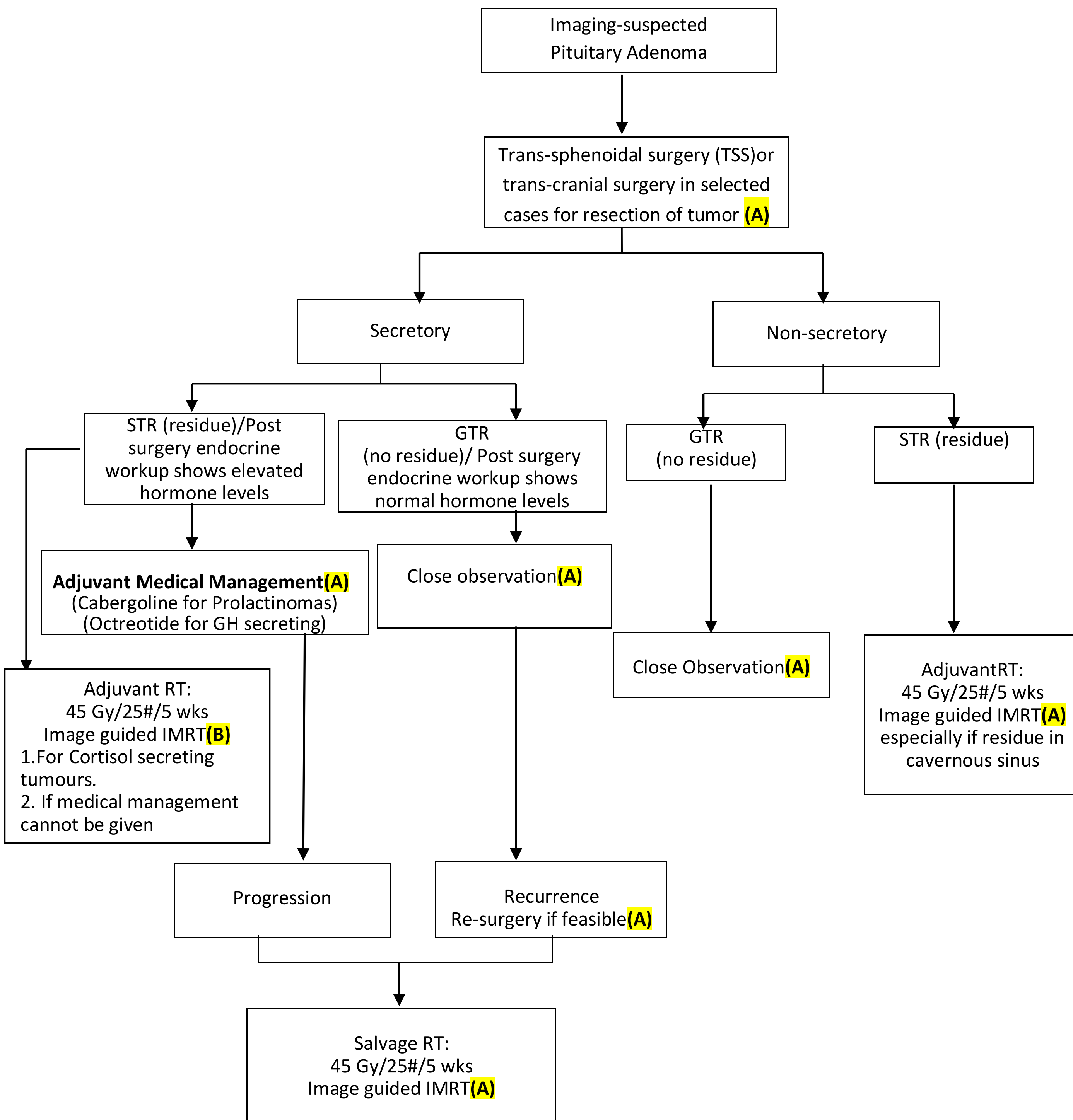


Refer to the pathology section For Molecular testing in meningiomas

A= MANDATORY

B= OPTIMAL

C= OPTIONAL



A= MANDATORY

B= OPTIMAL

C= OPTIONAL

Algorithm 9: SporadicAcoustic Schwannoma (Non-NF-2)

MRI s/o Acoustic Schwannoma

Factors affecting management
1. Size
2. Hearing

Size >3cm
Or tumour with cystic degeneration

Surgery **(A)** with intraoperativenerve monitoring **(B)**

GTR/NTR

Observe **(A)**

Residual

Small

Observe **(B)**

Large

Image-guide IMRT
54 Gy/30#/6wks **(A)**

Fractionated IMRT: 54Gy/30#/6wks **(A)**
OR
Smaller residual not abutting brainstem can also be treated safely with SRS **(A)**

Size ≤3 cm or (intracanalicular) asymptomatic

Hearing Preserved

Yes

Observation with regular MRI **(A)**

If significant increase on surveillance MRI, then treat SRS **(B)** or fractionatedIMRT: 54Gy/30#/6wks **(B)**

No

RT: SRS **(A)** or IMRT **(A)**
OR
Micro-neurosurgery (trans-labyrinthine) **(B)**

A= MANDATORY

B= OPTIMAL

C= OPTIONAL

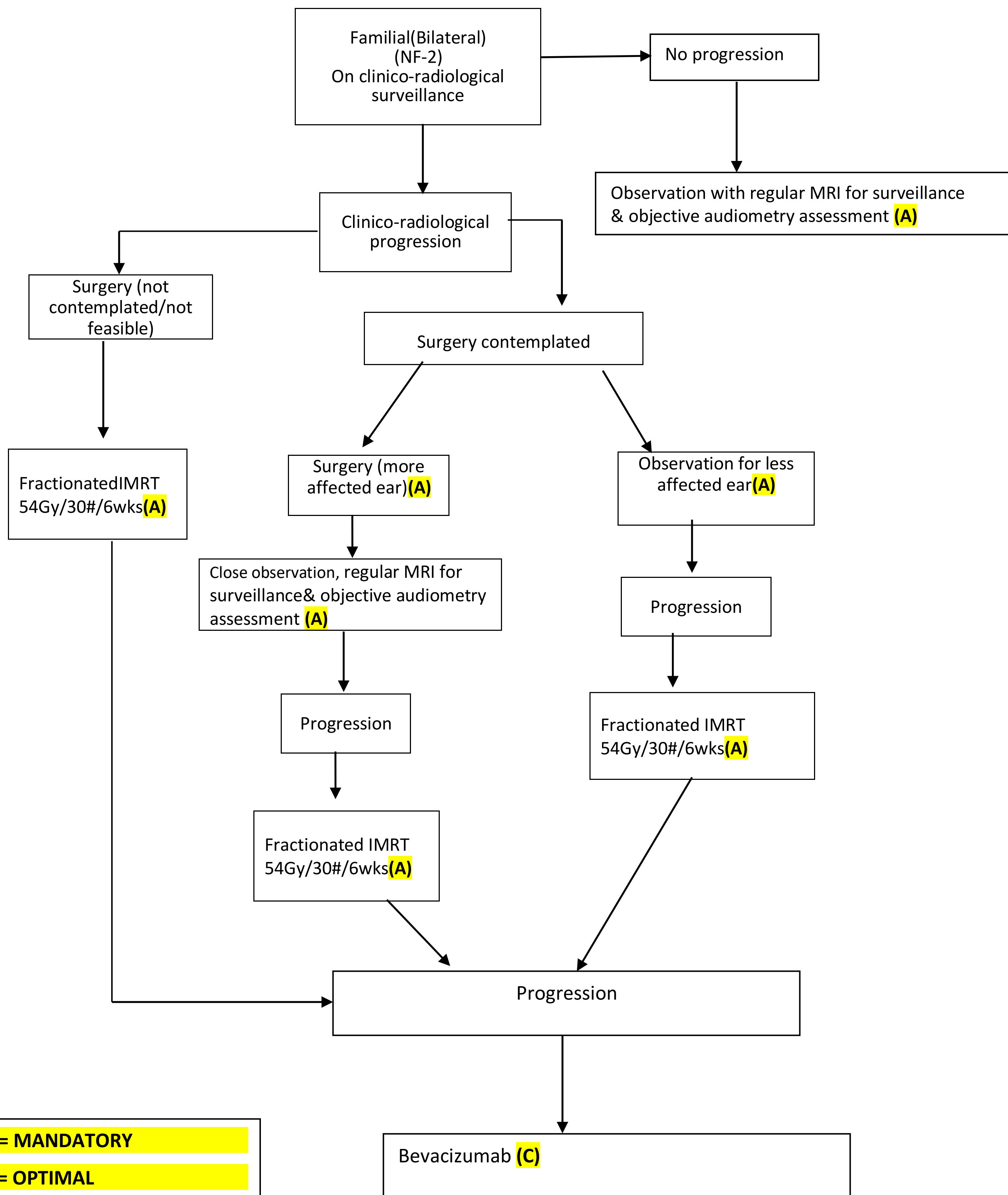
For SRS USE KOO'S GRADING SYSTEM OF TUMOUR DESCRIPTION

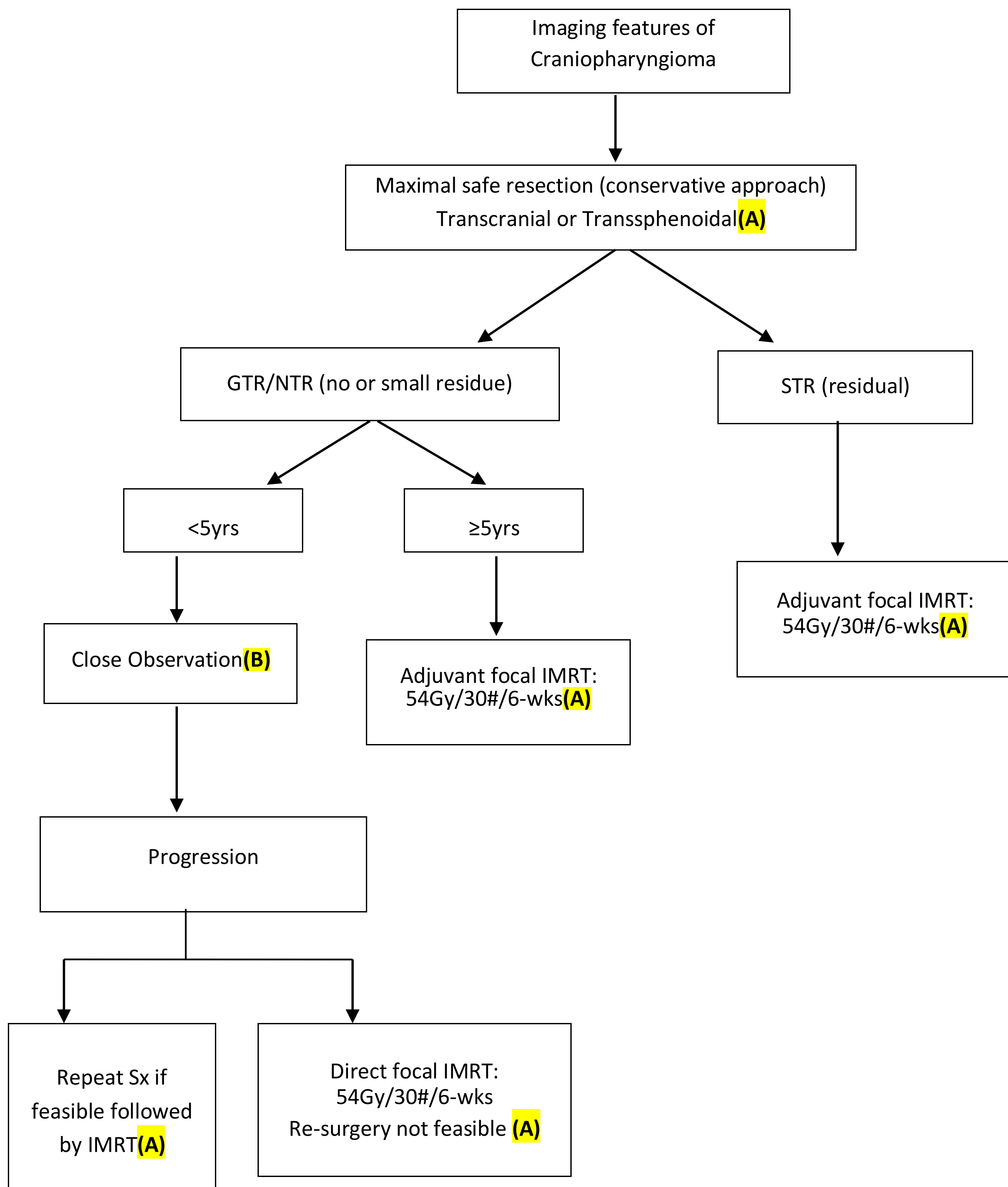
G1: SMALL INTRACANALICULAR TUMOUR

G2:TUMOUR PROTRUDES INTO CP ANGLE, NO CONTACT WITH BRAIN STEM

G3:SMALL TUMOUR INVOLVING INTO CP CISTERN, NO BRAIN STEM DISPLACEMENT

G4: LARGE TUMOUR WITH BRAIN STEM AND CRANIAL NERVE DISPLACMENT


Management Algorithm for NF-2 associated Bilateral Acoustic Schwannoma
Familial(Bilateral) (NF-2) On clinico-radiological surveillance
No progression
Observation with regular MRI for surveillance & objective audiometry assessment (A)
Clinico-radiological progression
Surgery (not contemplated/not feasible)
Surgery contemplated
FractionatedIMRT 54Gy/30#/6wks(A)
Surgery (more affected ear)(A)
Observation for less affected ear(A)
Close observation, regular MRI for surveillance& objective audiometry assessment (A)
Progression
Progression
Fractionated IMRT 54Gy/30#/6wks(A)
Fractionated IMRT 54Gy/30#/6wks(A)
Progression
Bevacizumab (C)
A= MANDATORY
B= OPTIMAL
C= OPTIONAL



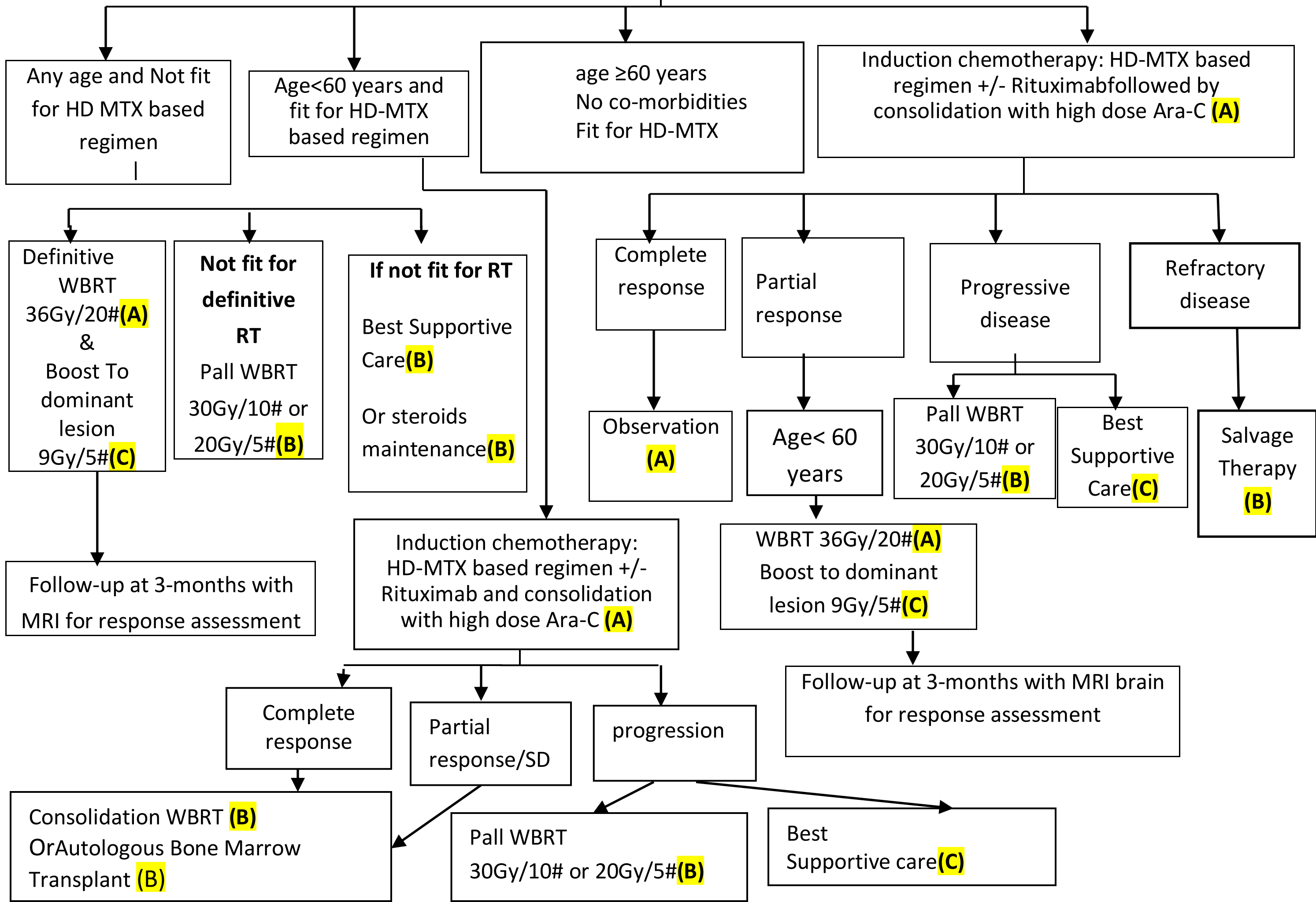
A= MANDATORY

B= OPTIMAL

C= OPTIONAL

NCG DRAFT GUIDELINES

Primary CNS Lymphoma (PCNSL)

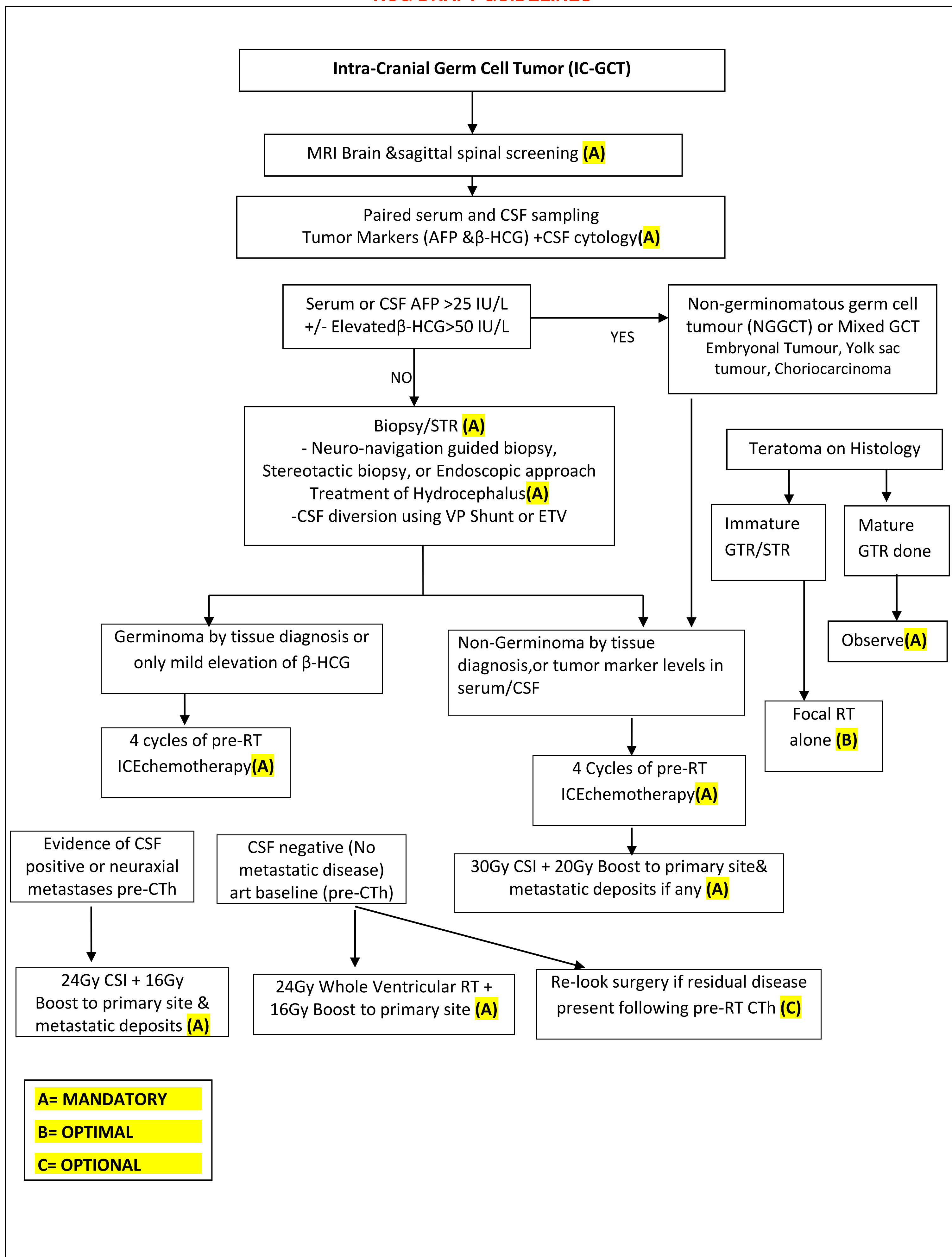


A= MANDATORY

B= OPTIMAL

C= OPTIONAL

***Response assessment should be done with MRI using T1+Contrast, T2W, T2FLAIR, Perfusion and Diffusion sequences**


Intra-Cranial Germ Cell Tumor (IC-GCT)
MRI Brain &sagittal spinal screening (A)
Paired serum and CSF sampling
Tumor Markers (AFP &β-HCG) +CSF cytology(A)
Serum or CSF AFP >25 IU/L
+/- Elevatedβ-HCG>50 IU/L
YES
Non-germinomatous germ cell tumour (NGGCT) or Mixed GCT
Embryonal Tumour, Yolk sac tumour, Choriocarcinoma
NO
Biopsy/STR (A)
- Neuro-navigation guided biopsy, Stereotactic biopsy, or Endoscopic approach
Treatment of Hydrocephalus(A)
-CSF diversion using VP Shunt or ETV
Teratoma on Histology
Immature
GTR/STR
Mature
GTR done
Observe(A)
Germinoma by tissue diagnosis or only mild elevation of β-HCG
Non-Germinoma by tissue diagnosis,or tumor marker levels in serum/CSF
Focal RT alone (B)
4 cycles of pre-RT ICEchemotherapy(A)
4 Cycles of pre-RT ICEchemotherapy(A)
Evidence of CSF positive or neuraxial metastases pre-CTh
CSF negative (No metastatic disease) art baseline (pre-CTh)
30Gy CSI + 20Gy Boost to primary site& metastatic deposits if any (A)
24Gy CSI + 16Gy Boost to primary site & metastatic deposits (A)
24Gy Whole Ventricular RT + 16Gy Boost to primary site (A)
Re-look surgery if residual disease present following pre-RT CTh (C)
A= MANDATORY
B= OPTIMAL
C= OPTIONAL

Chemotherapy regimens for ICGCT

Drugs	Dose	Days and Route
ICE Regimen (3-weekly for 4 cycles)		
Ifosfamide	1500mg/m^2	Days 1-5 IV
Carboplatin	600mg/m^2	Day 1 only IV
Etoposide	100mg/m^2	Days 1-3 IV
Germinoma: A2-drug combination chemoRx for 4 cycles is recommended: Carboplatin/etoposide alternating with Ifosfamide/Etoposide or alternatively Ifosfamide, carboplatin and etoposide for 4 cycles		
NGGCT: A3-drug combination for 4 cycles is recommended: Ifosfamide/Cisplatin (Alternating with carboplatin) and Etoposide or alternatively Ifosfamide, carboplatin and etoposide for 4 cycles		

Brain Metastases from Extra-Cranial Solid Tumors

MRI highly suggestive of Brain Metastases

Limited Brain Metastases (1-3)

Whole Body FDG-PET/CT **(A)**
or
CT scan of Thorax + Abdomen + Pelvis **(A)**

Disseminated disease
Poor systemic Rx options

Best Supportive Care **(B)**
Palliative WBRT **(B)**
30Gy/10#/2-wks
20Gy/5#/1-wk

Stable systemic disease
Good systemic Rx options

Resection for lesion in non eloquent area **(A)**

*SRS/hypofractionated SRS **(B)**
OR
$Hippocampal sparing WBRT + tumour bed boost **(B)**

Resection not done or not feasible

*SRS/hypofractionated SRS **(B)**
OR
$Hippocampal sparing WBRT + tumour boost **(B)**

Response Assessment MRI

Multiple Brain Metastases (>4)

Whole Body FDG-PET/CT **(A)**
or
CT scan of Thorax + Abdomen + Pelvis **(A)**

Disseminated disease
Poor systemic Rx options

Best Supportive Care **(B)**
Palliative WBRT **(B)**
30Gy/10#/2-wks
20Gy/5#/1-wk

Stable systemic disease
Good systemic Rx options

$Hippocampal sparing WBRT + tumour boost **(B)**
SRS in select cases **(C)**

Response Assessment MRI

A= MANDATORY
B= OPTIMAL
C= OPTIONAL

$Hippocampal sparing WBRT dose: 30Gy/10#/2-wks with simultaneous integrated boost to tumour/tumour bed for total dose of 45-50Gy/10#

*SRS/hypofractionated SRS dose depends upon the total volume of all brain metastatic disease taken together

Single fx SRS dose: As per RTOG guidelines
Hypo-SRS dose: 27Gy/3# or 32.5Gy/5#