Anti-α-Fetoprotein antibody-quantum dots

Anti-AFP-QDs

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Chemical name:	Anti-α-Fetoprotein antibody-quantum dots	
Abbreviated name:	Anti-AFP-QDs	
Synonym:		
Agent category:	Antibody	
Target:	α-Fetoprotein (AFP)	
Target category:	Antigen	
Method of detection:	Optical, near-infrared (NIR)	
Source of signal\contrast:	Quantum dot	
Activation:	No	
Studies:	• *In vitro* • Rodents	Click on protein, nucleotide (RefSeq), and gene for more information about AFP.

Background

[PubMed]

Fluorescent semiconductor quantum dots (QDs) are nanocrystals made of CdSe/CdTe-ZnS with radii of 1–10 nm (1-3). They can be tuned to emit in a range of wavelengths by changing their sizes and composition, thus providing broad excitation profiles and high absorption coefficients. They have narrow and symmetric emission spectra with long excited-state lifetimes of 20–50 ns, *versus* 1–10 ns for fluorescent dyes. QDs possess good quantum yields of 40–90% and high extinction coefficients, and they are more photo-stable than conventional organic dyes. QDs can be coated and capped with hydrophilic materials for additional conjugation with biomolecules such as peptides, antibodies, nucleic acids, and small organic compounds, which were tested *in vitro* and *in vivo* (3-7). Although many cells have been labeled with QDs *in vitro* with little cytotoxicity, there are

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limited studies of long-term QD toxicity in small animals (8-16). However, little is known about the toxicity or the mechanisms of clearance and metabolism of QDs in humans.

α-Fetoprotein (AFP) is a single-chain glycoprotein (70 kDa) that is highly expressed in the fetal liver, gastrointestinal tract, and yolk sac (17); serum AFP levels are markedly low (<3 ng/ml) in healthy adults. Synthesis of AFP in adults appears in a variety of disease states, often associated with increased concentrations of AFP in serum. Markedly high serum levels are found in cancer patients with hepatoblastomas, nephroblastomas, hepatocellular carcinomas (HCC), and certain testicular tumors. Yu et al. (18, 19) prepared QDs conjugated with anti-AFP monoclonal antibodies to detect accumulation and retention of AFP at the site of HCC tumors. Anti-AFP-QDs are being studied as a contrast agent for imaging AFP expression in HCC cancer cells.

Synthesis

[PubMed]

CdSe-ZnS QDs (with emission peaks at 590 nm) modified with thioglycolic acid were activated with 50 mmol 1-(3-dimethyl-aminopropyl)-3-ethylcarbodiimide and 5 mmol *N*-hydroxysuccinimide in phosphate-buffered saline (18). Mouse anti-human monoclonal AFP antibody was incubated with the activated QDs at room temperature for 2–4 h. The anti-AFP-QDs were isolated with centrifugation and purified with dialysis. The assembled anti-AFP-QDs have a spherical diameter of 5 nm, as measured with low-temperature transmission electron microscopy. The number of copies of antibody per QD was not reported.

In Vitro Studies: Testing in Cells and Tissues

[PubMed]

Anti-AFP-QDs were examined for their ability to discriminate between the AFP-expressing HCC cell line HCCLM6 and the AFP-negative human colon cell line SW480 (20). *In vitro* imaging showed that anti-AFP-QDs (100 nM) could bind to HCCLM6 cells after 4 h of incubation but not to SW480 cells. Furthermore, anti-AFP-QDs (100 nM) exerted little effect on cell viability in culture for 48 h.

Animal Studies

Rodents

[PubMed]

Chen et al. (20) performed *ex vivo* biodistribution studies of anti-AFP-QDs (200 nmol/kg) administered to normal mice ($n = 5$) *via* intravenous injection. The plasma half-life of anti-AFP-QDs was ~2 h. The tissue with the highest Cd (measured with inductively coupled plasma-mass-spectrometry) accumulation at 24 h was the spleen (~10% μg/g

tissue), followed by the liver (~7% μg/g tissue) and kidneys (~2% μg/g tissue). There was minimal accumulation in the brain, heart, muscle, and lung. Anti-AFP-QDs were taken up by the reticuloendothelial system and by phagocytes in the liver and spleen. The mice showed no acute toxicity when compared with mice injected with saline. No signs of sickness were observed in the mice for up to 7 days after injection. Whole-body imaging of mice bearing HCCLM6 tumors and small-cell lung metastases showed a good near-infrared fluorescence signal in the tumor and lung metastases, with approximately four-fold enhancement as compared with saline injection. The near-infrared fluorescence signal was localized to both primary and metastatic tumor cells as confirmed with staining and confocal microscopy. No blocking experiment was performed.

Other Non-Primate Mammals

[PubMed]

No publication is currently available.

Non-Human Primates

[PubMed]

No publication is currently available.

Human Studies

[PubMed]

No publication is currently available.

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